How to ADD SOUND TO YOUR HOME MOVIES

1.75 A FOCAL MOVIEBOOK

37417 Niles Blvd
Fremont, CA 94536

510-494-1411
www.nilesfilmmuseum.org

FOCAL CINEBOOKS

HOW TO FILM
by G. Wain

HOW TO SCRIPT
by Oswell Blakeston

HOW TO DIRECT
by Tony Rose

HOW TO PROJECT
by Norman Jenkins

HOW TO TITLE
by L. F. Minter

HOW TO PROCESS
by Leslie Wheeler

HOW TO USE COLOUR
by C. L. Thomson

HOW TO CARTOON
by J. Halas & B. Privett

HOW TO EDIT
by H. Baddeley

HOW TO ACT
by Tony Rose & Martin Benson

HOW TO USE 9.5 mm.
by D. M. Neale

HOW TO MAKE HOLIDAY FILMS
by H. Baddeley

HOW TO MAKE 8 mm. FILMS
by N. Bau

HOW TO WRITE FILM STORIES
by R. Harrison

Each 7/6 net

First published in 1954

Printed in Great Britain 1954 by
The Bay Tree Press, Stevenage, Herts

D. M. Neale

HOW TO ADD SOUND

to amateur films

FOCAL PRESS
London and New York

Contents

A Sound Idea

When you are drowsy, you close your eyes. So long as you are conscious, however, your ears remain active. Consequently, you find nothing incongruous in sound without sight. Even when your eyes are open, you often hear sounds through an open doorway or from a source otherwise invisible. The gramophone and radio therefore seem natural enough and you can readily believe that only the loudspeaker grille prevents you from seeing the musician you hear.

The reverse is not true. It is far from easy to watch an event at close quarters without also hearing what is going on. Soundproof windows are a rarity. It is not surprising, therefore, that the silent films you show at a children's party should be greeted by cries of "Where's the sound?" and "Why can't you hear them?" A completely silent moving picture is an artificial monstrosity. It can be saved by making it realistic, or by making it artistic.

Realism demands that the appropriate sounds shall be heard at the appropriate time. We are so accustomed to the perfection of the professional cinema and television, that we may not appreciate the difficulties involved in achieving this. But if a man's voice is observed only a fraction of a second before or after his lip movements, you lose the illusion of watching a real man speaking. Nor must a door slam before or after it is shut. The sound must be synchronised with the action. It must come when we expect it, or not at all.

The professional cinema took thirty years to find a satisfactory solution to the problem. In the meanwhile anything from an upright piano to a full orchestra was used to provide a musical accompaniment to silent films. You cannot expect a large audience to watch a drama in complete

silence. Somebody will titter at the wrong place, and the mood of the audience will then cease to follow the film. But if you provide even quiet music, the titter will not be heard and if you choose the music with care, you can rely on its keeping the audience in a receptive mood.

Music for Atmosphere

The provision of such music, often called *mood music*, can transform a silent film from an artificial monstrosity to an artistic masterpiece. You may not consider your own films potential masterpieces, but mood music can nevertheless improve them immensely. Landscapes which are disappointingly monotonous when seen in silence become charged with atmosphere when accompanied by the right music. Continuity of sound can mask poor continuity of picture. Where you failed to prepare pictorially for a dramatic sequence, it can often be ushered in by music which is subtly menacing. In short, your old films will appear twice as good with mood music.

And what of your new films? Will music still be required when you have learnt from the mistakes you made in your earlier efforts? It will always help. And if you shoot your film with a certain piece in mind, there is a wealth of new fields for you to explore. You will not be the first to provide a visual interpretation of "Rustle of Spring". But you may be the first to visualise a Bach Fugue in terms of the everyday round of a housewife. With a little care, you can edit your film to fit a gramophone record as accurately as if the music had been written for the film.

Commentaries and Effects

Nor are you confined to the use of commercial gramophone records. You can now make, or have made, recordings of your voice or almost any sounds you require. It is thus a relatively simple matter to record a commentary for your holiday film, pointing the shots with interest, humour and

spontaneity in a way impossible when using titles alone. You can also add sounds such as the roar of traffic or the crash of breakers. The only restriction lies in the accuracy with which you attempt to synchronise it.

If you are prepared to expend the necessary time, money and effort, you can produce realistic synchronised sound fully comparable with the work of the professional. In later chapters, this book shows you how to do this. But primarily we are concerned with ways in which you can add effective sound simply and cheaply.

Simple Methods

Let us now consider how the music is to be provided. A live performance calls for a good musician and adequate rehearsal. In general, it will be much simpler to get your music from a loudspeaker.

Using the Radio

This immediately suggests the use of a radio. Very few homes are without a radio to-day and, if you must cut your costs to a minimum, it has obvious merits.

It has also several drawbacks. The choice of music is limited to that being broadcast at the time of your show. If you are lucky in finding a suitable programme on the night of the show, you will have to start the film at exactly the right time. Also the larger your audience, the more difficult it is to enlist their co-operation. Either they will refuse to be ready in time, or they will resent a delay of five minutes while awaiting the start of the programme.

Once the show starts, you may find that in parts, the mood of the music conflicts with that of the picture. There is little you can do about this, as a search for other material from another station will distract the audience more than the unsuitable music. A less serious problem is the interruption of the programme by announcements. You can cut these out by manipulating the volume control, but of course this leaves periods of silence.

Radiograms

If you have a radiogram, or a record-playing desk, you can get over many of these troubles by using gramophone

records. Within the limits of your collection of records, you can then use the music best suited to the films. Moreover you can start the show when the audience is ready—a factor contributing to a good reception.

Using a radiogram, you will now encounter a new difficulty. For best effect, the loudspeaker should be by the screen. This suggests that, to change records, you must sit near the screen and hence away from the projector. Fortunately there is a simple solution to this problem: use the radiogram to operate an extension speaker standing near the screen. The speaker in the radiogram must, of course, be switched off or disconnected. Using this arrangement, you can set up the projector near the radiogram so that record-changing is simplified.

When you use a gramophone turntable and pick-up in connection with a radio set, an alternative solution is possible. By using a long screened lead from your pick-up, you can stand the set by the screen and the turntable by the projector. The screened lead is a special type of wire in which a flexible outer covering woven from fine wires shields an insulated wire or wires running down the middle. Properly used, it can protect the feeble output of the pick-up from interference in the form of hum. The outer screening should be connected to one of the two sockets on the radio marked "Pick-up" or "P.U." If you connect it to the wrong socket, the hum will become very much worse, but matters will be improved on reversing the connections.

Hum may also be pronounced if your radio set is of the kind which has an electrical connection between the metal chassis or framework inside and the mains. All A.C./D.C. sets have a "live" chassis of this kind and so also do many sets marked "A.C. only". If the hum is troublesome with such a set, try reversing the two mains leads. With a two-pin plug, merely unplug and plug in again, the other way round. If the set is wired to a three-pin plug, you must open the plug and interchange the leads going to the two smaller pins.

Danger: Live Chassis

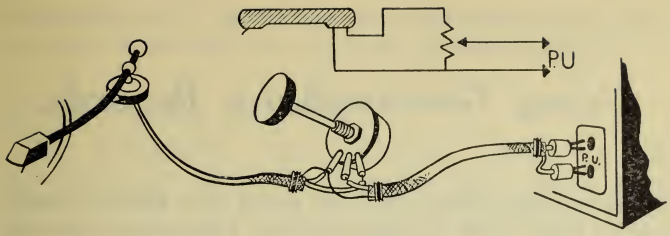
A serious warning must be issued here. Never touch the chassis of a live-chassis radio while it is plugged in, even though it may be switched off. Neither must you attempt to connect to earth the chassis of such a set. If you go about things in the wrong way, you may receive a fatal shock. Unfortunately there is no really safe and simple way of telling whether or not your set has a live chassis. So if you are not familiar with such matters, consult a radio serviceman. He will, if necessary, make all the connections needed for the record player and assure you that there will be no danger in using it.

Provided, however, that you make your connections only to the sockets marked "Pick-up", you cannot go far wrong. Having connected the screening of the pick-up lead to the appropriate socket, there may still be a little hum. This will probably disappear when you connect a wire between the framework of your turntable motor and the screening of the pick-up lead. Alternatively, try connecting the turntable framework to earth. (There is no necessity to run a wire to a metal plate buried in the earth. If your electricity points are properly installed, the large, third pin of a three-pin socket should be amply good enough. Alternatively, scrape the paint from a cold-water pipe and fit an earth clip. But do not use a gas pipe as an earth, it is a highly dangerous practice.)

Do not feel alarmed at these warnings right at the beginning. But having warned you against the misuse of your equipment, we shall explain how to use it to the best advantage.

Volume Control

If your record player does not already boast a volume control, you must either provide one or get a radio serviceman to fit one. The pick-up leads should be soldered to the outer two of the three tags on the volume control. One of



The leads from a gramophone pick-up (*left*) are connected to the outer tags of a volume control (*centre*). From the centre tag and one outer tag, leads are taken to the input sockets of an amplifier or radio set.

the outer tags is also connected to the screening of the lead to the radio. The centre tag is connected to the wire running down the centre of the screened lead and going to the other socket on the radio.

The resistance of the volume control may easily affect the quality of the music, making it deficient in either treble or bass. Crystal pick-ups are particularly critical in this respect. A resistance somewhere between 100,000 ohms (0·1 megohm) and 1·0 megohm is usually required. If the music is too boomy, try a lower resistance value. If it is too thin, use a higher one.

You will need this volume control to adjust the volume of the music to suit your films. Also a sudden break in the music distracts the audience, so fade the music out before removing one record and fade it in at the start of the next.

Using Gramophone Records

We have noted already that the mood of a piece of music seldom follows that of a film for long. You can get over this difficulty by making your film fit a chosen record. However, this imposes limitations. It is much simpler to accompany the different sequences of your film with suitable excerpts from a variety of records.

Thus you may use peaceful music to show two people walking over the hills. When they come to a rushing stream, however, you will change to something more lively. The change from one record to another necessitates a short break if only one turntable is available. When the turntable spindle is sufficiently long, some people drop the new record on top of the old one. This practice saves only a little time, however, and it is liable to scratch the records.

No matter how adept you become, you are unlikely to complete a change of record in under two seconds. If you have to start the new record at a selected point, it will take a good deal longer. You must make the break in the music as inconspicuous as possible, so use the volume control to fade out one record and fade in the next. If you can fade out the first record at a cadence, a pause of several seconds will often pass unnoticed provided the record is changed without fuss. With a little practice, you will find it easy to recognise, and even anticipate, a cadence. This is the point at which the music comes to rest on its keynote, just as a hymn tune does at the end of each verse.

Needle-changing is another difficulty associated with the use of a single turntable. Since there is not enough time to change a worn needle between records, you are forced to use a semi-permanent needle at least. This tends to

emphasise needle scratch from the loudspeaker and, unless you use a lightweight pick-up, record wear is increased.

Long-Playing Records

The long-playing type of record, running at $33\frac{1}{3}$ revolutions per minute offers apparent advantages over the older standard of 78 r.p.m. The $33\frac{1}{3}$ r.p.m. records play for as long as 25 minutes per side as against $4\frac{1}{2}$ minutes per side for the 78 r.p.m. records. Also the long-playing discs are almost unbreakable. On the other hand, they are very easily scratched by the rough treatment they are likely to receive when you make a hurried change-over in the dark.

The longer playing time is of little value because it is seldom that the mood of a piece of music accurately follows that of a film for even $4\frac{1}{2}$ minutes. Finally, the closer pitch of the grooves makes it much more difficult to select a particular passage in a record without a mechanical aid (see p. 29).

Because a work occupies so many more discs when recorded at 78 r.p.m., you stand a fair chance of finding excerpts you want on separate discs. Then, if you load these in the right order on an automatic record player, there is no need to handle records in the dark. This means you can use your radiogram directly without the need of an extension speaker. However, unless you can contrive remote control of the "Reject" knob on the auto-changer, it is better to have the radiogram near the projector. You can then reject a record part-way through if the latter part of the record is unsuitable or if the music tends to lag behind the picture.

Twin Turntables

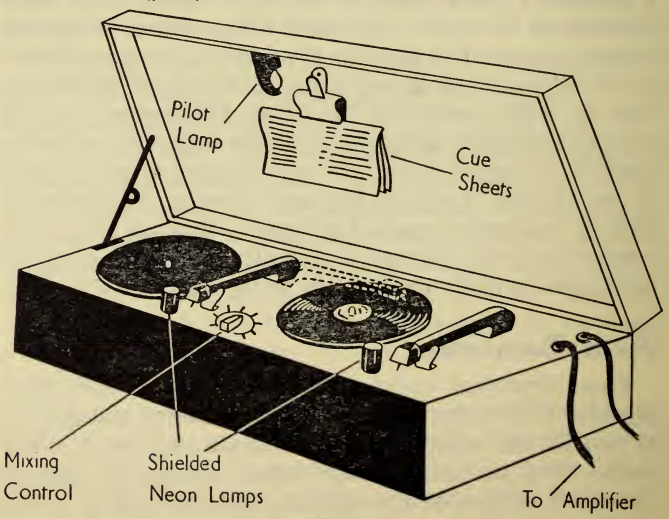
These difficulties vanish if you use two turntables, each provided with a separate pick-up. By lowering one pick-up as you lift the other, you can eliminate any break in the music. The transition is still rather abrupt, but can be smoothed by one of the methods described on p. 17 to

control separately the volume of the music from each pick-up. With such a control, the procedure is slightly different.

Just before the change, place the second pick-up on the selected part of the new record. As the appropriate shot appears on the screen, turn the control knob or knobs so that the volume of the first record gradually drops while that of the second record increases. When the change-over is complete, lift the first pick-up from the record and change the needle if necessary. Then, while the second record is still playing, remove the first record and replace it by the third. You are now ready for the next change-over.

With a little practice you can provide closely timed and highly effective mood music in this way. Moreover, simple sound effects are possible too and, since you have two turn-

The ideal twin turntable set-up has the two turntables mounted side by side, and one pick-up arranged so as to cover both discs. Other refinements are shielded neon lamps to illuminate the stroboscope speed control (p. 21), a mixing control (p. 17), and a pilot lamp to illuminate the cue sheets (p. 26) in the lid.



tables, they can be superimposed where necessary. For example, a record of a crowd cheering can be mixed with another of a military band. Together they would provide a realistic accompaniment to a film of a procession. As a matter of fact, much of the sound accompanying a newsreel is often "assembled" in this way.

Although each turntable will have a separate pick-up, it is a good plan to mount one of them so that it can be swung to operate on either turntable. If you are using two separate record players, you will have to place them side by side to do this. Also the turntable plates must be at the same level.

Watch the needle of one pick-up and see whether you can swing it exactly over the centre of its turntable. Probably it will overhang by $\frac{1}{4}$ inch or so. Now swing this pick-up over the other turntable and move things about until you get exactly the same overhang there. Provided you can swing it far enough round—it has to turn through nearly half a circle—this pick-up can be used equally well on either turntable. Then, should occasion arise, you can place both pick-ups on one record and make a smooth transition from one part of a record to another part of the same side. Of course you must arrange to use this particular record on the turntable over which both pick-ups can be swung.

Mixing Circuits

Using two pick-ups to feed a single amplifier, you will need some way of deciding which pick-up is going to be heard from the loudspeaker. Switches are not enough. The volume from each pick-up must be controlled smoothly and independently of the other. Nor is it sufficient to provide each pick-up with a volume control and connect the leads directly together. In this case, fading one pick-up right down will short-circuit the other.

You can get over this by putting a resistor in the lead from the centre contact of each volume control. The lead to the amplifier is taken to the other end of each resistor and so it

cannot be short-circuited to "earth" by rotation of either volume control.

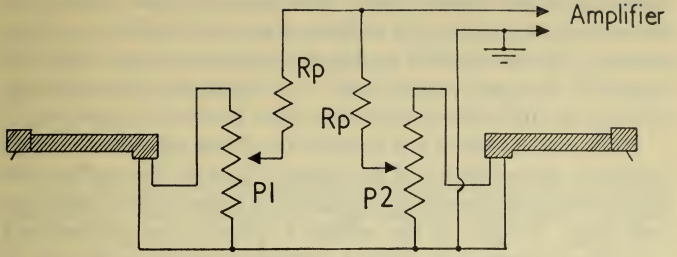
A radio dealer can supply suitable resistors for a few pence apiece. He may call them "padding-out resistors" if you discuss the circuit with him, but they are just ordinary radio resistors, none the less. They should have about the same resistance as the volume controls: usually between 0·1 and 1·0 megohm.

Using padding-out resistors sometimes makes the amplifier more prone to hum. A centre-tapped volume control provides a popular alternative free from this defect. The centre tap is on the opposite side of the control from the other three tags. It is connected to the earth lead which is common to the amplifier and one side of each pick-up. Each end of the volume control is connected to the output of one pick-up and the sliding contact goes to the amplifier input. Rotation of the control from one end to another progressively reduces to zero the volume from one pick-up before introducing gradually increasing volume from the second pick-up.

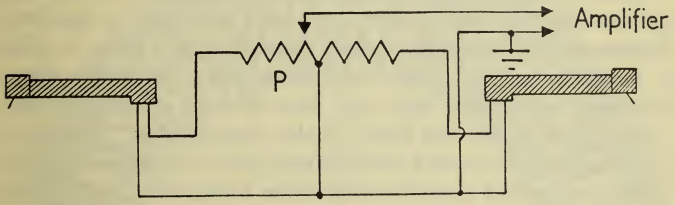
The centre-tapped control is really two volume controls in one. The overall resistance must therefore be double that of the control you normally find satisfactory with each pick-up alone (p. 13).

For a simple fade-over, the centre-tapped control is a very convenient arrangement, since it means there is only one knob to turn. On the other hand, it cannot be used for mixed sound effects from both pick-ups together.

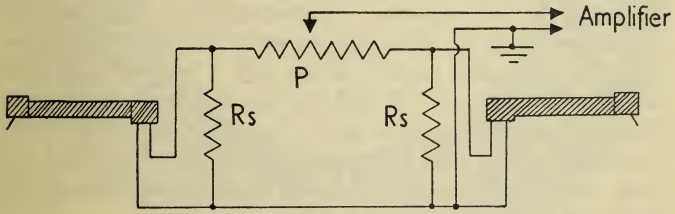
A third alternative overcomes this difficulty by using a separate mixing control. The volume is then adjusted by the control usually present on the amplifier. In this arrangement a resistor is connected across the leads from each pick-up and one end of each resistor is connected to the "earth" of the amplifier. The other side goes in each case to one end of a potentiometer, the sliding contact of which goes to the amplifier input. If you know the resistance of the volume control normally working well with your pick-up, use



In this mixing circuit, the potentiometers P_1 and P_2 act as separate volume controls for the two gramophone pick-ups. Padding-out resistors, R_p, of about the same resistance as P_1 and P_2, are necessary in this arrangement.



A single centre-tapped potentiometer P_1 provides a simple and convenient alternative arrangement.



With this circuit a single potentiometer, P, serves as both volume control and fade-over for the two pick-ups. Each resistor R_s has about one-tenth the resistance of the potentiometer P.

resistors of the same value. The potentiometer must then have about ten times this resistance to work well as a mixing control. In the middle position, the two pick-ups feed the amplifier in equal proportions. At either end, one pick-up is heard at full volume while the other is severely attenuated.

Even this circuit is not entirely free from drawbacks. For example, the position of the mixing control may affect the tone quality of the music, particularly when crystal pick-ups are used. To get all the effects required, the professional sound engineers use mixing consoles nearly as big as a cinema organ. Don't expect perfection from the simple circuits described above, but they will give sufficient flexibility to produce very good results.

Auto-couplings

Twin turntables are useful mainly because they enable you to change quickly from one piece of music to another. However, they are also a great help when you want to play a single piece of music occupying more than one disc. Provided successive sides are recorded on different discs, you can eliminate the break at the change-over. You play the first record on one turntable and pick-up. Before it ends, place the second record on the other turntable. As the first record ends, lower the other pick-up on to the second record and quickly fade from the first pick-up to the second. This requires careful timing and rehearsal. Also, unless you buy records arranged in auto-couplings, you will need a duplicate set of records. Auto-couplings are intended primarily for use on gramophone units incorporating auto-changers. The first record carries side 1 and the last side, the second record side 2 and the last but one, and so on. Some companies provide pairs of shorter works in auto-couplings. Thus two overtures may be arranged back to back on two discs instead of each overture occupying the two sides of a single disc.

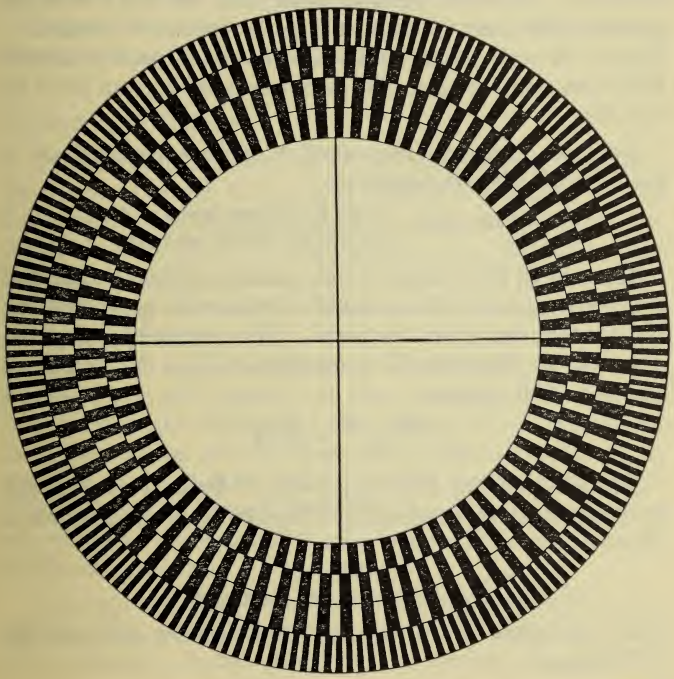
When you are playing two consecutive sides of a single work, the two turntables must run at exactly the same speed.

If they do not, there will be an unpleasant change in pitch of the music at the change-over. Fortunately it is easy to check your turntable speeds if you have alternating current (A.C.) mains supply.

Stroboscopes

The electric current flowing through a lamp operating from A.C. mains constantly reverses its direction. It does

A typical stroboscopic disc for use on a gramophone turntable. When illuminated by a lamp running on an A.C. supply, each set of bars appears stationary at a particular speed of rotation. Reading from outside to centre, the rings contain 180, 78, 77 and 76 bars respectively. With a 50-cycle A.C. supply, these correspond to speeds of $33\frac{1}{3}$, 76·9, 77·9 and 78·9 r.p.m.



this at twice the frequency of the supply. The usual 50-cycle supply therefore produces 100 reversals of the current per second. At each reversal the current falls momentarily to zero and the brilliance of the lamp falls also. Although our eyes cannot normally detect this rapid flickering, we can use it to observe the speed of a gramophone turntable.

Most gramophone dealers stock stroboscopic discs, consisting of a card, about the size of a gramophone label, and printed with black and white spokes or bars. When you rotate a disc of this kind, the white spaces between bars are seen most clearly when the light is momentarily most brilliant. While the light is momentarily less brilliant, the white spaces are less easily seen. So if the white spaces are always in the same position each time the light is at its greatest brilliance, the bars and spaces appear to stand still. Since a 50-cycle supply makes a lamp reach peak brilliance 100 times every second, 100 bars must pass a given point in that time.

You can calculate the number of bars required on a stroboscope from the equation:

$$\text{No. of black bars} = \frac{\text{Light flickers per second} \times 60}{\text{Revolutions of disc per minute}}$$

There must always be a whole number of bars on the disc and consequently you cannot always provide a stroboscope for exactly the speed required. For example, using the equation to determine the number of bars for a record running at 78 r.p.m.:

$$\frac{100 \times 60}{78} = 76{\cdot}92$$

The best you can do is to provide 77 bars. Then you can calculate the speed at which the 77 bars will appear stationary. Thus:

$$77 = \frac{100 \times 60}{\text{Revolutions of disc per minute}}$$

and so the speed is 77·92 r.p.m., which is quite close enough to 78 r.p.m.

Commercial stroboscopic discs sometimes carry three rings of 76, 77 and 78 bars. These correspond to speeds of 78·9, 77·9 and 76·9 r.p.m. respectively. Do not be misled by the purely coincidental similarity in this case between the number of bars and the r.p.m. A disc for $33\frac{1}{3}$ r.p.m. requires 180 bars.

When you are changing records frequently, it is inconvenient to keep putting a stroboscopic disc on the record, only to remove it later. You can always make an immediate speed check, by marking 77 bars around the turntable rim. This you can do most readily by painting the bars on a piece of paper of the right length and then sticking this round the rim. Be sure that the bars are of even thickness and uniformly spaced.

Some commercial turntables already carry stroboscopic bars around their rim.

Types of Motor

If the turntable motors are of the synchronous type, then the speed at which they run is determined entirely by the frequency of the electricity supply. If the motor drives the turntable directly, or through gearing, the turntable speed will also depend on the mains frequency. You can check whether your turntable is truly synchronous by using a stroboscopic disc (p. 21). One set of bars should show absolutely no progressive creep either forward or backwards. There will probably be some swaying of the pattern, due to slight eccentricity, but you can ignore this. Variations in mains voltage, or in stiffness of the lubricating grease, or the drag of the pick-up, will not affect the turntable speed. Using a pair of such turntables, you will never have to worry about the possibility of a speed difference between consecutive records.

If the pattern on a stroboscopic disc always shows a little slip one way or the other, the turntable is probably driven by an induction motor. Most modern electric turntables use

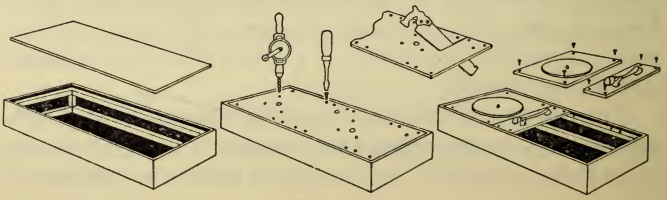
this kind of motor. It runs at a speed largely, but not entirely determined by the mains frequency. Two- and three-speed turntables mostly use a friction drive of some sort which introduces a slight degree of slip on the driving belt or roller. Small variations in speed can therefore arise with such turntables. These variations are of no account with a single turntable, but they become important with two. Unfortunately you cannot readily make small speed adjustments to this type of turntable.

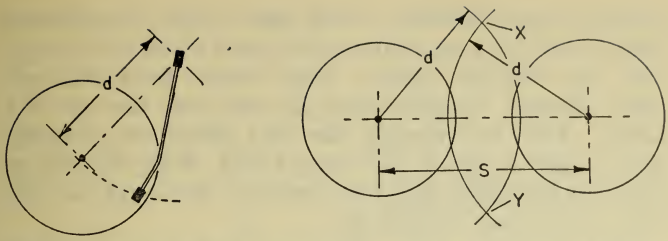
A third type of turntable motor uses a mechanical governor similar to that used on a spring motor. An adjusting knob or lever is provided near the turntable plate and this gives a continuous adjustment of turntable speed over a fair range. For special purposes, you may sometimes wish to play a record at an abnormal speed. In such a case, a governor control is very useful. Usually, however, you are more concerned with getting two turntables to rotate at exactly the same speed. The governor gives the necessary control and you can check its adjustment with the aid of a stroboscopic disc.

Mounting the Turntables

It is a good idea to re-mount two record players in a single cabinet with a hinged lid. If the original motor boards are rectangular, you can screw or hinge them to a common frame of wood 1 × 1 inch or stouter. Alternatively you can

A useful twin-turntable unit can be made from 1-inch framing covered with three-ply and provided with a seven-ply motor board. After preliminary assembly, remove the motor board and saw it into sections so that each turntable and pick-up can be removed separately.





For every pick-up, there is a correct distance d at which the pivot must be set from the turntable centre (*left*). If you mount two turntables (*right*) so that the spacing S is less than twice d, you can mount a pick-up to operate on either turntable. From each centre, draw an arc of radius d. The points X and Y where they cross are suitable centres for your pick-up pivots.

fit the motors to a single piece of seven-ply. Should a defect arise, however, it is useful to be able to inspect each motor separately. Best of all, then, mount the motors and pick-ups on a new seven-ply board and screw it to the frame temporarily. Then remove it and cut it into separate boards for each motor and each pick-up. When you screw the four pieces on to the frame once more, the screw holes already made ensure a neatly lined up job.

The rest of the case you make by covering the 1 × 1 inch framing with hardboard or three-ply. This withstands hard wear, yet is light enough to be portable.

When mounting the pick-ups, see that they are pivoted at the correct distance from the turntable centre. With a new pick-up, this important dimension is usually specified, or a template is provided. In re-mounting an existing record player, carefully repeat the original spacing. Generally the stylus of the pick-up should over-swing the turntable centre by about $\frac{1}{4}$ inch to provide good tracking. That is, the stylus should always be trailing as nearly as possible along the groove, not obliquely to it.

If you want to be able to use one pick-up on both turntables, mount it at the correct distance from both centres. Suppose you know that it should be mounted at

8 inches from the centre. Then take a piece of cardboard about a foot long and near one end make a hole to fit snugly over the turntable spindle. Eight inches from this hole make another, through which you can push the end of a pencil. Then by swinging the card about the turntable centre, draw an arc on the motor board. With the card on the other turntable, repeat the process. Where the two arcs cross, you mount the pick-up.

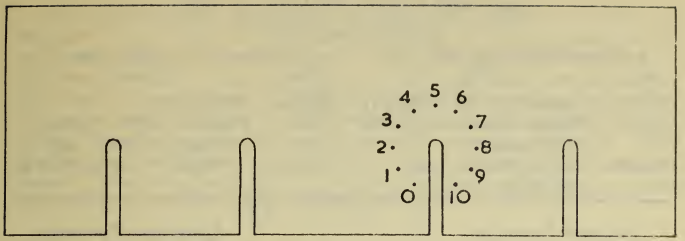
When you are working the turntables, you must have enough light to see what you are doing. But you must not shine a lot of unwanted light on the screen. So mount a small pilot light near each pick-up. Pygmy neon lamps are ideal for this purpose, for their light is not intense, yet they give by far the clearest effect with stroboscopic markings.

Provide a strut to support the lid of the cabinet during a show. Then even the feeble light of the neons will be kept from the screen. A useful refinement is a bulldog clip screwed inside the lid to hold a cue sheet where it will be illuminated by a third pilot lamp.

Cue Sheets

To simplify presentation, prepare a cue sheet for each of your films. This is a table detailing the records required, the cues for change-over and the settings of the volume and fade-over controls. These control settings you indicate by reference to a sequence of numbers marked around each control knob. You may, for example, provide each control with numbers from 0 to 6. Then on a volume control, 6 corresponds to full volume and 0 to none. Similarly 0 on the fade-over control indicates full anti-clockwise rotation, i.e., full output from the left-hand pick-up. On the same control, 6 indicates full output from the other pick-up, 3 equals output from both pick-ups.

If you are using a radio set as an amplifier, there is no need to mark a scale permanently against any of its controls. Instead, cut slots in a piece of card so that it will slip behind



A card of this kind can be slipped behind the knobs of a radio set to provide a numbered scale for the volume or tone control.

the various knobs and over their respective spindles. Then mark the scale of numbers on the card which is put in position only for film shows. You will, of course, require a reference point on the knob to indicate its setting. This can be a line or dimple scratched or drilled in the knob and filled with white paint. If you object to doing this, stick an arrow-head of white tape on the knob and remove it later.

The nature of your cue sheet will depend largely on your equipment. Simple equipment needs only a relatively simple cue sheet. A more detailed cue sheet (p. 28) may cater for twin turntables and pick-ups, each with its own volume control, and also a fade-over control.

In the cue sheet each operation is timed from a particular scene in the film. If you are going to operate the turntables yourself, this will suffice since you are familiar with your own films. However, if a friend is working the turntables, he may have no idea how long to wait for the next cue. Therefore provide him with a clock and timing notes on the cue sheet. Alternatively, you can list an advance cue in a separate column. For example, the advance cue might be "Vacuum cleaner, four seconds". This would mean that four seconds after the start of the shot of a vacuum cleaner, the important cue (e.g., a hand lifting a gramophone soundbox) will be seen on the screen. This gives the operator sufficient warning so that he will be ready to lift the pick-up in exact synchronism with the picture.

CUE SHEET FOR "HAVEN OF REST"

Records Required:—

Left-hand Turntable (No. 1)		*Right-hand Turntable (No. 2)*	
No.	Title	No.	Title
C1395	Rhapsody in Blue (side 1)	B8112	Præludium
C3273	Hassan; Intermezzo and Serenade	E583	English Train Noises
DB2896	The Enchanted Lake (side 2)	C1667	Morning, Noon and Night in Vienna (side 2)

Left-hand Turntable			*Cue*	*Fade-over Control*	*Right-hand Turntable*		
Record No.	*Volume Control*	*Procedure*			*Procedure*	*Volume Control*	*Record No.*
			Dim lights	6		3	B8112
			Titles	6		5	
C1395	4	Lower pick-up at shot 1	Shot 1	0	Remove		
		Lift pick-up in synchronism	Hand lifts gram. arm	6			
	3	*Pick-up No. 1 on turntable No. 2* Effect (b)	Map	6			E583
	3		Engine	0	Effect (c)	3	
		Remove and start on next record	Train	6			
C3273			Title: "Keswick"	Slowly to 0	Remove		
		Remove	Title: "Lodore Falls"	6	Start half-way through side 2. Gradually raise volume to	2 4	C1667
DB2896	4	Start ½ inch from edge	Packing rucksack	0	Remove		

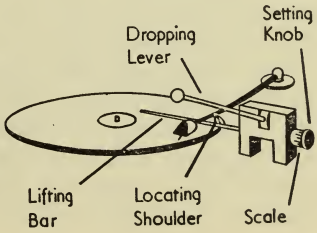
The sample sheet *opposite* shows fade-overs from one record to another. There is also an example of the use of both pick-ups on the same record; thus Train Effect (b) ("Train Starting") is followed rapidly by Train Effect (c) ("Train in Motion"). Although these two effects are recorded on the same disc, a fade-over is possible from one to the other if you play the record on the right-hand turntable. Play effect (b) with pick-up No. 1 which can be swung to operate on either turntable. Make the fade-over to pick-up No. 2 which is playing effect (c) on the same record. Then swing pick-up No. 1 back to the left-hand turntable ready for a fade-over to the record waiting on it.

Locating Points

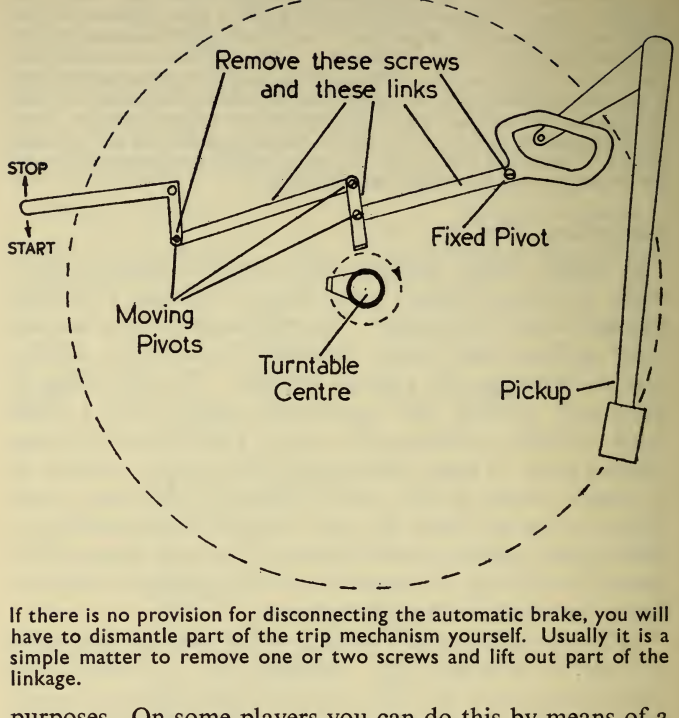
A rather similar problem arises with records. After a while you may become quite adept at finding a selected passage at the first attempt. Your presentation can become more polished and certain, however, if you have a positive way of indicating the passage required. The old dodge of previously marking the appropriate groove with a chalk mark is likely to damage the record, particularly the long-playing type. A more satisfactory arrangement consists of a pointer swung by the pick-up across a graduated scale. Enter on the cue sheet the scale marking corresponding to the required passage on the record. Then you have only to swing the pick-up to repeat the scale reading in order to lower the needle in the right groove.

When attaching such a pointer to the pick-up, remember to make it extremely light. Modern pick-ups operate with stylus pressures of less than half an ounce. A clumsy pointer will more than double this pressure and damage the records.

If your record player has an automatic brake, you will find it almost essential to disconnect it for mood music



This typical groove-locating mechanism may be used with standard pick-ups. Turning the setting knob moves the locating shoulder along the lifting bar supporting the pick-up arm. When the scale reading is correct, the dropping lever is depressed, allowing the lifting bar to lower the pick-up gently on to the record.



If there is no provision for disconnecting the automatic brake, you will have to dismantle part of the trip mechanism yourself. Usually it is a simple matter to remove one or two screws and lift out part of the linkage.

purposes. On some players you can do this by means of a small lever provided on the motor board. On others you will have to lift off the turntable plate and, after studying the auto-brake linkage, decide which screw to remove. You may then be able to attach your pointer to the disused radius arm on the pick-up and so avoid adding weight to it.

The safest and most accurate pointer is an enlarged shadow of the pick-up head. By carefully positioning a small flashlamp in a blackened hood on the motor board, you can throw a shadow of the pick-up on to a scale in the cabinet lid or along the front of the motor board. This produces a weightless pointer a foot long or more.

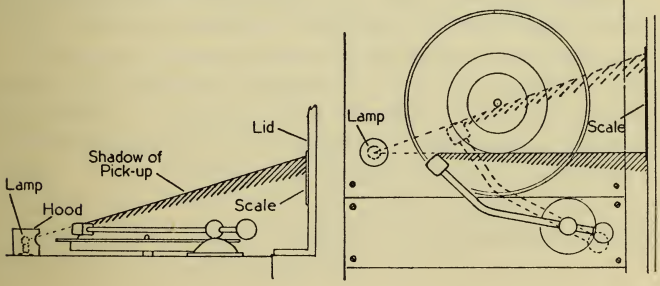
Presentation

Whenever possible, preface the film with a short introductory record. As it ends, switch off the room lights and stand by the projector ready to start it with the second record. At the end of the film, you will need an additional record for interval music. This will entertain the audience while you thread the next film in the projector. Choose something over which they may converse easily and choose the mood of the interval music as carefully as that for the films. It should contrast mildly with the preceding film. After heavy drama, use soothing music. After a peaceful travel film choose something sprightly. See also that it sets the mood for the next film on the programme.

Even with a detailed cue sheet to help you, you can still make mistakes with the records. You can miss a cue, or discover too late that you have forgotten to change records. Keeping track of all these points is part of the fun and a perfect presentation is well worth the effort involved.

On the other hand, you will find that even with pilot lights it is inconvenient to operate turntables in semi-darkness. Also the audience may easily be distracted by the unavoidable sounds and movements occasioned by changing records.

A flashlamp near the front of the motor board can throw an enlarged shadow of the pick-up on to a scale in the lid and so facilitate location of a required passage in a record.



If you have an assistant, your whispered comments are a further distraction.

Ideally you require a separate room or booth for the turntables and projector (p. 144). There are then no restrictions on light and noise.

Commentaries

It is sufficiently difficult to manipulate projector and turntables single-handed, without attempting to deliver a commentary at the same time. Even if you have an assistant, a live commentary presents all sorts of difficulties. These troubles are largely removed, however, if you record your music, sound effects and commentary so that you can play them through in step with your film. Mood music can be re-recorded so that you are no longer changing gramophone records every minute or so. The commentary will be word-perfect every time. Because the presentation is greatly simplified, you can provide better sound accompaniments with less fuss and bother.

Recording Sound

Drop a pebble into a still pond. There is a little splash and rings of ripples spread out in all directions. Have you ever paused to think just what is happening? The water hit by the stone does not actually move out across the pond. If it did, it would carry with it all the leaves floating on the surface, and this obviously does not happen. What does spread out is something which makes the water level rise slightly. This something is a pressure wave.

Just as the stone disturbs the water and produces spreading ripples or pressure waves, so sound disturbs the air and produces similar pressure waves. Our ears detect these pressure fluctuations and convert them into nerve impulses. A microphone does a very similar job, converting the fluctuations of air pressure into fluctuations of voltage.

The voltage variations produced by a microphone are usually very small. We must therefore amplify them considerably to obtain sufficient power to operate, say, a loudspeaker. The loudspeaker then converts the variations of voltage or electrical pressure into variations of air pressure. These should constitute an exact replica of the original pressure waves except that they will be of greater or lower intensity according to the degree of amplification used.

Now suppose that in some way we make a detailed record of how the electrical pressure from the microphone varies from instant to instant. Then we need not use the pressure variations immediately to operate a loudspeaker. Instead, we can at any time use our detailed record to construct a sequence of pressure variations exactly similar to those we recorded. When these are applied to a loudspeaker it again reproduces the original sounds.

System	*Recording*	*Speed of Recording Medium*	*Typical Maximum Frequency Response (cycles/second)*	*Approx. Relative Co of Adding Sound*
Commercial discs, non-synchronised	By artist(s) in studio	78 r.p.m. 33⅓ r.p.m.	8,000 12,000	0
Synchronised disc	In studio, by you, or to order	78 r.p.m.	8,000	24
Magnetic wire	At home	24 ins./sec.	8,000	6
Magnetic tape (Twin track)	At home	7½ ins./sec. 4·8 ins./sec. 3¾ ins./sec.	9,000 6,000 5,000	6 4 3
Magnetic stripe 16 f.p.s.	At home, after editing film	4·8 ins./sec.	5,700	35
Magnetic stripe 24 f.p.s.	At home, after editing film	7·2 ins./sec.	8,500	Monochrom (reversal) 1* Colour 15
Optical, 24 f.p.s.	In studio, by you, or to order	7·2 ins./sec.	5,000	Monochrom (reversal) over 300 Monochrom (neg.-pos.) over 400

*Including cost of extra film stock involved by increase of film speed fro

Adequate nchronisation	*Projector Noise Exclusion*	*Sound Editing*	*Film Repairs affect Sync.*	*Sound for borrowed films*	*Manipulaton for Projection*
Music and effects	No problem	Done during projection	No	Yes	Elaborate
ommentary, music and effects	Sound-proof studio	Very difficult	Yes	Using non-sync. discs	Elaborate, danger of wrong disc
ommentary, music and effects	Difficult	Difficult	Yes	Yes	Double normal
Commentary, music and effects	By pilot commentary technique	Simple / Very simple / Simple	Yes	Yes	Double normal
Post-recorded lip-sync. speech, ommentary, music and effects	Difficult	Difficult	No	No	Foolproof
Direct lip-ync. speech, ommentary, music and effects	Sound-proof studio	Simple, but adds to expense	No	No	Foolproof

f.p.s. to 24 f.p.s.

System	Recording	Speed of Recording Medium	Typical Maximum Frequency Response (cycles/second)	Approx. Relative Cost of Adding Sound
Commercial discs, non-synchronised	By artist(s) in studio	78 r.p.m. 33⅓ r.p.m.	8,000 12,000	0
Synchronised disc	In studio, by you, or to order	78 r.p.m.	8,000	24
Magnetic wire	At home	24 ins./sec.	8,000	6
Magnetic tape	At home	7½ ins./sec. 4·8 ins./sec. 3¾ ins./sec.	9,000 6,000 5,000	6 4 3
Magnetic stripe 16 f.p.s.	At home, after editing film	4·8 ins./sec.	5,700	35
Magnetic stripe 24 f.p.s.	At home, after editing film	7·2 ins./sec.	8,500	Monochrome 95* Colour 170*
Optical, 24 f.p.s.	No commercial facilities	7·2 ins./sec.	4,800	—

*Including cost of extra film stock involved by increase of film speed fron

Adequate Synchronisation	*Projector Noise Exclusion*	*Sound Editing*	*Film Repairs affect Sync.*	*Sound for borrowed films*	*Manipulation for Projection*
Music and effects	No problem	Done during projection	No	Yes	Elaborate
Commentary, music and effects	Sound-proof studio	Very difficult	Yes	Using non-sync. discs	Elaborate, danger of wrong disc
Commentary, music and effects	Difficult	Difficult	Yes	Yes	Double normal
Commentary, music and effects	By pilot commentary technique	Simple Very simple Simple	Yes	Yes	Double normal
Post-recorded lip-sync. speech, commentary, music and effects	Difficult	Difficult	No	No	Foolproof
—	—	—	No	No	Foolproof

5 f.p.s. to 24 f.p.s.

System	*Recording*	*Speed of Recording Medium*	*Typical Maximum Frequency Response (cycles/second)*	*Approx. Relative Cost of Adding Sound*
Commercial discs, non-synchronised	By artist(s) in studio	78 r.p.m. 33⅓ r.p.m.	8,000 12,000	0
Synchronised disc	In studio, by you, or to order	78 r.p.m.	8,000	24
Magnetic wire	At home	24 ins./sec.	8,000	6
Magnetic tape	At home	7½ ins./sec. 4·8 ins./sec. 3¾ ins./sec.	9,000 6,000 5,000	6 4 3
Magnetic stripe 16 f.p.s.	At home, after editing film	2·4 ins./sec.	3,000	20
Magnetic stripe 24 f.p.s.	At home, after editing film	3·6 ins./sec.	4,500	Monochrome 50* Colour 60*
Optical	Not practicable	—	—	—

*Including cost of extra film stock involved by increase of film speed from

Adequate Synchronisation	*Projector Noise Exclusion*	*Sound Editing*	*Film Repairs affect Sync.*	*Sound for borrowed films*	*Manipulation for Projection*
Music and effects	No problem	Done during projection	No	Yes	Elaborate
Commentary, music and effects	Sound-proof studio	Very difficult	Yes	Using non-sync. discs	Elaborate, danger of wrong disc
Commentary, music and effects	Difficult	Difficult	Yes	Yes	Double normal
Commentary, music and effects	By pilot commentary technique	Simple	Yes	Yes	Double normal
Post-recorded lip-sync. speech, commentary, music and effects	Difficult	Difficult	No	No	Foolproof
—	—	—	—	—	—

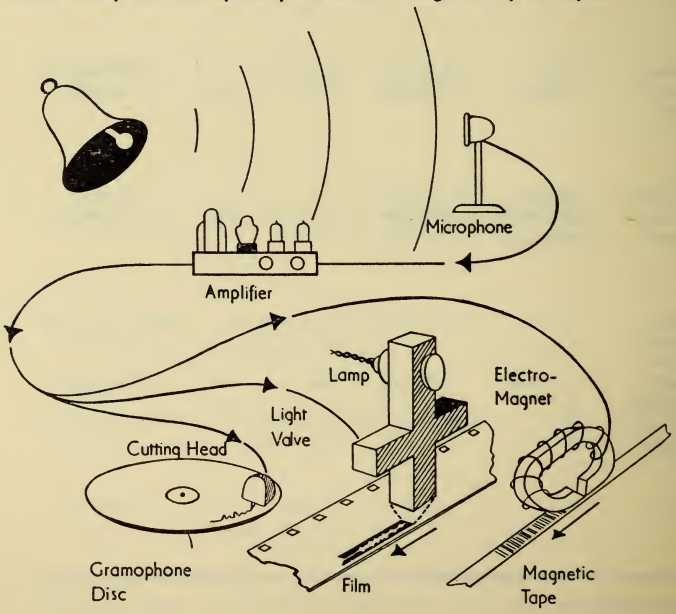
6 f.p.s. to 24 f.p.s.

The Choice of Systems

The main methods of sound recording we shall be concerned with are disc recordings, optical (photographic) sound tracks on the film, magnetic tape and wire recordings, and magnetic stripe tracks on the film.

None of these systems is ideal in every respect, but each method has its particular advantages and drawbacks. Your choice will necessarily be a personal decision striking a balance between many factors. At least one of them is the equipment you already have at hand. Thus if you have a sound-on-film projector, optical sound recording is worth considering. But if you use 8-mm. film, this method is out

Systems of sound recording. A microphone converts sound waves into electrical pulsations. After amplification, these can be recorded mechanically on disc, optically on film, or magnetically on tape.



of the question, since no optical sound projectors are available for that gauge.

Let us therefore look at the different systems in more detail.

Disc Recordings

The process of recording and reproduction is exemplified in the familiar gramophone record. A device very like a gramophone pick-up cuts a wavy groove in a lacquer-coated disc. Each electrical pressure variation produces a corresponding vibration of the cutting needle. The record you buy is a perfect copy of the lacquer original, but made in much harder material. When you play this record with a pick-up, the needle is forced to vibrate to follow the waviness of the groove. The pick-up then transforms the vibrations of the needle into electrical pressure variations which can be amplified and used to operate a loudspeaker.

From the point of view of initial cost, it is hard to better the disc system. The majority of households owning a ciné camera have also a gramophone and a radio. If these are not already available, they can be picked up quite cheaply secondhand.

Once you have built up a library of records, you can readily provide music to accompany almost any film. The process requires the minimum of preparation in advance and costs nothing since the same records can be used for many films.

To the ultra-critical, the hiss or scratch of the needle in the groove may be objectionable. Yet whichever system of sound recording we use, this needle scratch will be present if we draw on gramophone records for our music. Fibre or thorn needles considerably reduce the scratch or surface noise. There is another argument in their favour: people are more willing to lend you their records if you can assure them that you use only this type of needle. On the other hand, these needles must be changed frequently and even with twin turntables this is a nuisance. A good quality

light-weight pick-up using a sapphire stylus is more convenient. It will play hundreds of records before it requires attention, and it is just as kind to them.

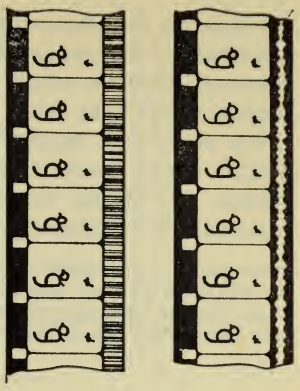
So much for non-sync; that is to say records chosen and played to fit the film fairly well. When you want records made to fit your film, problems appear. It is not a simple matter to make your own recordings on discs. However well the equipment is designed, it still requires very careful manipulation. One mistake ruins a disc costing several shillings. Fortunately, commercial recording facilities are available and at a reasonable price. These services make it unnecessary for you to have recording equipment of your own. You can leave the manipulation of the recorder to a skilled technician and concentrate on producing the commentary or effects you require. The result will be a set of high-quality recordings which you can play on your twin turntables (see also p. 51).

Many years of research have brought the quality of disc recording and reproduction to a very high standard. Notes and overtones containing as many as 8,000 vibrations or cycles a second are commonly recorded. Some of the latest recordings extend to 14,000 cycles. This is beyond the limit of hearing of many middle-aged and elderly people and far beyond the capabilities of even the best radio set on the medium waveband.

Frequency response is not everything, however. There are inherent difficulties in reproducing mechanically these very high frequencies. Other methods of recording and reproduction have therefore been developed which do not use a vibrating needle.

Optical Recordings

Professional cinema films carry sound recorded photographically alongside the picture. This arrangement has several advantages over the use of a separate disc. The photographic sound record is printed in the same operation



In 16-mm. one set of perforations is omitted to make space for the optical sound track. The film on the left has a variable density track, that on the right a variable area track. In either case the track is produced by modulating the width or the intensity of the recording light by means of the impulses generated by the sound to be recorded.

as the picture and subsequently it cannot be lost, muddled or played out of step with the picture.

The original sound record is made by shining light through a narrow slit on to a photographic film. Variations in electrical pressure delivered by a microphone are applied to a light valve. This controls the amount of light exposing a narrow band on the photographic emulsion as the film moves past the slit. After development, the film carries a sound track letting more or less light through at different points along the track.

In a variable density recording, the width of the track is constant, but the opacity or density varies from point to point.

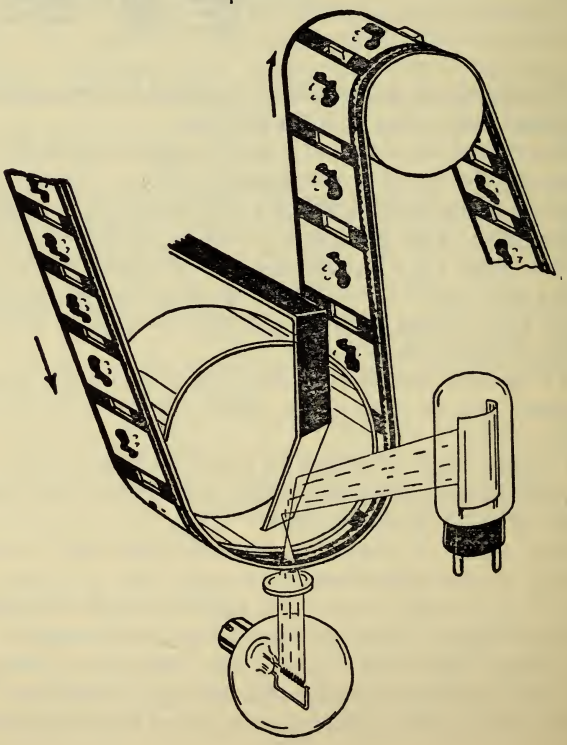
A variable area recording, on the other hand, produces a transparent track of varying width, bordered by two opaque bands, straight on the outsides.

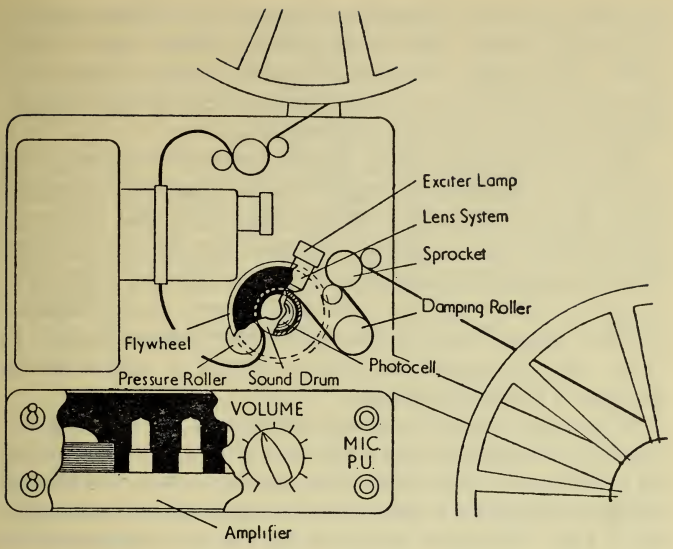
Both types of recording, variable area and variable density, can be reproduced in the same way. A narrow slit of light again shines on the film and the proportion passing through depends on the density or width of the track. This transmitted light falls on a photo-cell which passes an electrical current proportional to the light falling on it. So as the film passes rapidly past the slit of light scanning it,

the light on the photo-cell fluctuates rapidly. The current delivered by the photo-cell therefore fluctuates to provide electrical impulses which are a replica of those originally applied to the light valve.

The equipment required for reproducing sound from an optical sound track is not very complex. A lamp, lens system, photo-cell, amplifier and loudspeaker are the principal components. Consequently optical sound film

In the optical reproduction of sound, the sound track along the edge of the film (here 9·5-mm.) passes round the scanning drum, and obstructs a light beam to a greater or lesser extent. This varies the intensity of the light beam which falls on the photo-cell.





Film leaving the gate of an optical sound projector passes round a sound scanning drum coupled to a heavy flywheel to ensure smooth rotation. A pressure roller prevents the film from slipping on the drum and a sprung damping roller provides a constant driving tension irrespective of any "snatch" from the teeth of the sprocket pulling the film.

An exciter lamp and lens system project a fine slit of light on to the sound track and the transmitted light falls on a photo-cell inside the sound drum. The photo-cell is connected to an amplifier operating a loudspeaker by the screen.

projectors are widely used by amateurs as well as by professionals. The films used on them are recorded almost exclusively by professionals, however. This is because the production of an optical sound track requires elaborate apparatus beyond the resources of most amateurs. On the other hand, there are commercial concerns prepared to make the necessary recordings to order and an increasing number of amateurs are availing themselves of their services.

The quality of the sound you can get from an optical recording on 16-mm. film depends on the excellence of the

recording service. But the best apparatus, however carefully operated, cannot record frequencies much above 5,000 cycles per second. Even this requires a film speed of 24 pictures or frames per second instead of the 16 f.p.s. usually employed by amateurs for silent films.

The cost is higher than disc recording in the long run because you must have a copy of your picture made on the same film as the sound. With colour this also incurs an appreciable loss in quality. On the other hand, you have the advantage of having picture and sound on a single film. Anyone can show this on a standard 16-mm. sound projector without special instructions regarding synchronisation. In fact, once the sound has been recorded in step with the picture, it is there for keeps.

If you can record the sound directly on to the positive—i.e., if you do not have to copy from your original recording to get it on the same film as the picture—then you can get comparable results at the normal silent film projection speed of 16 f.p.s. However, this calls for the best equipment for both recording and reproduction. In any case, if you intend your film to be shown by strangers, you should use 24 f.p.s. This is the standard speed for an optical sound film and they will never believe that it should be shown at 16 f.p.s. At least, not until they have seen and heard it at 24 f.p.s.

Magnetic Tape Recording

A disadvantage of optical recording is that you cannot immediately play back a new recording to check that it is satisfactory. You must first develop and fix the film as with any other photographic emulsion.

Magnetic recording, on the other hand, does not suffer from this limitation. After recording, no processing whatever is required. You can therefore reproduce a magnetic recording immediately. With the necessary equipment, you can even reproduce the sounds while they are still being recorded. This greatly helps to get the best possible recording without waste of time and temper.

But perhaps the greatest attraction of the magnetic system is its economy. Not only is the raw material quite cheap, but you can use it over and over again. If you make an unsuccessful experiment, you can erase the recording and the magnetic material is as good as new. Again, you can hire a silent film from a library, record suitable sound on a magnetic tape and show the film all in one day. Then next time you hire a film, you can erase the first recording and make a new one, suited to the new film. Since the tape may be used repeatedly, the cost of adding sound to a film is negligible.

You can even superimpose one recording on another quite simply.

It is not surprising that, with all these points in its favour, the magnetic tape recorder has become a commonplace in only a few years. The tape it uses is sometimes paper, sometimes plastic. You can mark it fairly readily for reference and if you break it, you can repair it without audible effect.

A tape recorder costs about as much as a good electric gramophone. Here again, you may be able to recruit financial support, for a tape recorder will provide the family with unlimited entertainment. Besides recording the voices of your family and friends, you can "tape" radio programmes for playback at more convenient times. It is tempting to record concerts and recitals containing works not available on records. This may however constitute an infringement of copyright (p. 137), and until the legal position has been defined, recording from the radio cannot be practised openly.

The recording is made in the dull brown or black coating of iron oxide on one side of the tape. The process consists simply of magnetising the oxide from point to point in proportion to the electrical impulses from the microphone. The tape thus magnetised holds the recording of all the sounds passed into the recording circuit. To reproduce the sound the tape is fed through the same recorder, but in such a way that the variations in the magnetic field are picked up

and produce electrical impulses. These in turn are fed into an amplifier and loudspeaker system. The change-over from recording to reproduction is generally just a matter of turning a switch.

Synchronisation

Even an apparently simple commentary must be synchronised to the picture with an accuracy of better than 10 seconds. In fact it is sometimes difficult to accept a lack of synchronisation exceeding two seconds. You will, therefore, need some device to relate the speed of projection accurately to the speed of the tape.

Unfortunately, this is not a simple matter. Unlike film, the tape has no perforations. The smooth capstan provides only a friction drive, subject to slippage and creep which vary with the tensions of the feed and take-up reels. Moreover, the tape stretches and shrinks with variations in tension, temperature and humidity. Although these variations are very small—usually well under 0·5 per cent.—they soon add up. Even this small amount of stretch or slip will produce a timing error of two seconds in less than seven minutes.

Recording on Wire

Although magnetic tape is by far the most popular medium, two others must be mentioned—*wire* and *stripe*.

In a wire recorder, a thin steel wire replaces the magnetically coated tape. Also the take-up reel often runs at a uniform speed, 78 r.p.m., and so serves as a capstan. In other respects, the design of a wire recorder differs little from that of a machine using tape.

For a straightforward commentary, a wire recorder is admirable. But for more complicated sound recordings it is less convenient than a tape recorder. Wire is not conveniently marked for reference. Nor can you cut it and splice it as you can magnetic tape. If it spills off the reel, wire can get into an awful tangle. On the other hand it is

dimensionally more stable than tape, and, therefore, synchronisation is perhaps a little easier.

Stripe on Film

Stripe denotes an application of magnetic recording becoming extremely popular with ciné enthusiasts. The magnetic coating is applied directly to the film as a narrow stripe outside the picture area. The sound record is therefore carried by the film itself just as it is in an optical recording. In fact 16-mm. films are often made on single-perforated film so that the magnetic coating may be applied in the position which has been standardised for optical sound tracks. For the amateur who has shot many films on the usual double-perforated 16-mm. stock, however, this is not a convenient arrangement.

Alternative facilities are therefore available for applying the stripe at the edge of the film outside the perforations.

Magnetic stripe has been applied also to 8 mm. and 9·5 mm. In the case of 8 mm. the stripe is again placed outside the perforations and therefore does not detract from the picture area. In 9·5 mm. the narrow track partially overlaps the picture recorded by the camera. The projector gate is narrower than that in the camera, however, and consequently the stripe does not appear on the screen.

With magnetic stripe there are no difficulties of synchronisation. Since the magnetic recording is on the film itself, it cannot get out of step with the picture. In principle, you just project the film and record the music or commentary to fit the picture. If you get the timing exactly right when recording, the sound will be reproduced in perfect synchronisation on every occasion.

On the other hand the converse is equally true. Every so often you require a complex sound effect. In your anxiety to record it well you may easily misjudge the timing. If you record the sound out of step you have no choice but to erase it and try again. In general, this is a simple matter, but not always. On tape you can, if you wish, adjust the

timing by cutting out a few inches of tape, or splicing some in. With stripe you cannot do this.

Magnetic stripe is eminently suitable for fairly straightforward sound, music or commentary. But when you want to record complicated effects with accurate timing, there are difficulties. These you can overcome with patience or with a tape recorder.

Projectors designed for magnetic stripe invariably include facilities for recording as well as playback. So if you are going to lend your film to strangers, you run a risk of their accidentally erasing the sound. They might even replace it with a facetious commentary of their own. If you have spent a long time preparing the sound this will be exasperating. If you have made a film with lip-synchronised speech its erasure will be calamitous. For such purposes an optical sound track is the better choice.

Disc and Optical Recordings

Although the disc and optical systems are quite different in principle, it is convenient to discuss them together. Both systems require complex and expensive recording equipment.

In both cases, however, you can make recordings at commercial studios. Since you do not handle the recording equipment yourself, it makes very little difference during recording whether you are using disc or optical sound. Many studios record the sound first on magnetic tape and transfer it to disc or film later when you have approved it.

Postal Services

Most of the sound recording studios are situated in or around London. However, if you live in the provinces you can post your films to one of these studios. Here commentary, music and effects will be recorded to order.

If you wish, you can send just a few notes with the film and ask the studio people to write a commentary. They will send a draft to you and, when you have approved it, will record it in correct timing with your film.

Simple though this is, the success of the final commentary depends largely on you. A commentary should give information which is not evident from the picture. You must provide the studio with the necessary facts. Put yourself in their shoes. What could you make of this?

10	*LS*	An old half-timbered house—possibly a farmhouse.
11	*MLS*	The same house.
12	*MLS*	An old house with recent additions. A girl skips across the yard.
13	*MS*	A window in the side of a barn-like building.
14	*LS*	Youth walking by wall adjoining the barn-like building. He stops and turns.
15	*LS*	Landscape, evening. Fade-out.

Not much, probably. You cannot be sure whether shot 12 is of the same house as shots 10 and 11. And what is the connection with the barn-like building in shots 13 and 14? It is possibly miles away. Perhaps the film illustrates contrasting roof designs. Or was there something important about the windows? You see the difficulty?

Send the recording studios clear, factual notes:

Shots 1–9. The coach journey from Victoria Coach Station to Oldhurst (Wessex). This takes about four hours. The coach stops at the drive to "Timbersholme".

Shots 10–15. "Timbersholme" where we spent our holidays in 1953. It is a 14th-century farmhouse which has been converted into a guest house. The barn has been made into a recreation room and is used for country dancing. Shot 15 shows the view across the vale to the south.

They can then devise a commentary something like this:

"WONDERFUL WESSEX"

Approx. Time in Minutes	*Script*	*Film Sequence*
½	In 1953, our holidays started at Victoria Coach Station. There was plenty to see from the coach and it seemed a short four hours run into Wessex.	Boarding coach. Coach starting. Inside moving coach.
	Just outside Oldhurst, the coach stopped at the gate to "Timbersholme". We were glad we had only to carry our cases up the drive.	Coach stops. People carry cases.
1	After six hundred years as a farmhouse, 'Timbersholme' has been made into a guest house.	Views of "Timbersholme".
1½	The old barn is now a recreation room, with windows looking across the vale to the south. (*Please confirm.*)	The barn. Landscape. Fade-out.

You will see that the script has used all your facts except one. No mention is made of country dancing because it would make the audience expect shots of such good ciné material. Even in these few lines of commentary, however, the script writer finds your information inadequate. You should have told him where "Timbersholme" stands in

relation to Oldhurst. As it is he had to be content with "Just outside . . ." which is artfully ambiguous.

Later on, he badly needs a connection between the barn and the landscape. So he asks you to confirm that the barn looks across the vale. When you write your notes, try to foresee these difficulties and provide too much information rather than too little.

Since you must give so much thought to the commentary, you may consider doing the whole job yourself. A good commentary sounds easy, but it is not necessarily easy to write. One ill-chosen word can completely destroy the effect you are seeking. If this leads you to scrap your recorded commentary it will be cheaper to have the script written professionally in the first place.

When you project the film, you want to keep the recorded commentary in step with the picture. Your victims will not thank you if they see themselves entering the Zoo while the commentary is already naming the animals. You can, of course, adjust the projection speed to keep picture and sound in step. But you will find you soon forget exactly how they should fit. Then you let the errors accumulate until you come to a shot in which the lack of synchronisation is as obvious to the audience as to yourself. You can avoid this by using some sort of synchronising device. Similar problems arise in tape recording, and there are a variety of satisfactory solutions (p. 88). However, whereas tape recorders can provide half an hour or more of continuous sound accompaniment, your disc recordings will be limited to 4½ minutes. This is because the popular recording services cater only for 78 r.p.m. discs up to 12 inches in diameter. Now that 33⅓ r.p.m. turntables are readily available for long-playing discs, it is a good plan to adopt the slower-speed standard. It reduces the number of breaks to change records. This in turn means you are not forever trying to get the picture in step with a newly started record. However, you may have some difficulty finding a recording service for this standard.

Music and Effects

The recording studios can intersperse your commentary with music and sound effects if desired. This increases the cost of the recording by about one quarter. Here again, you can choose the type of music and sound effects to be added. Alternatively, the script-writer will do it for you.

Practically speaking, there is no limit to the sound effects at your disposal. The studios can usually find the effect you need in their comprehensive library. But if they cannot, they will be able to fake it quite readily.

With music things are not so simple. Copyright restrictions may prevent the studios from re-recording any record which strikes your fancy. So usually you must content yourself with indicating the kind of music you want—piano, dance, concert, symphony and so on.

Master Recordings

As a protection against accidents, the commentary is usually recorded first on magnetic tape. When the recording is satisfactory, it is re-recorded on to the disc or film, whichever you are using. In the case of film, the magnetic recording is kept at least until the film is developed. Then if the optical recording is not satisfactory, a second copy can be made from the tape.

Once you have got your disc or optical recording, the master recording on tape may be erased and the tape used for another job. However, the studios will usually retain the master for a small extra charge. Then if later on you want further copies—to replace worn discs, for example—you can get them made for a fraction of the original cost.

In the case of an optical sound track, you may not need to preserve a magnetic or disc master after you have got a satisfactory print. The optical recording is often made first on to a separate film. Later it is printed, with the picture, on to a single film to provide a married print. You can then keep the original optical recording as a master.

Optical Sound Practice

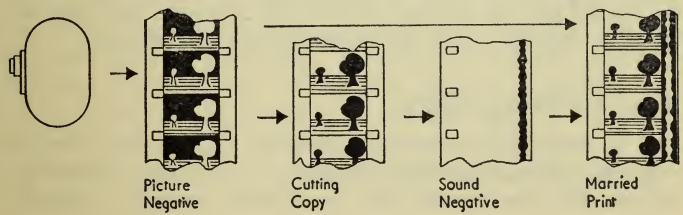
There are many ways in which you can fit optical sound to a film. Which you choose must depend on your resources and requirements, whether you work in monochrome or colour and the equipment available at the recording studios. Few, if any, studios can offer all the various alternatives, so in the long run you may have little choice of the system to use. Nevertheless it is useful to have a general knowledge of the different possibilities.

Negative-Positive

The classic way of producing a sound film requires at least three lengths of film in addition to the final copy. You have:

1. The picture negative.
2. The work print or cutting copy which is a silent positive made from the picture negative.
3. The sound negative.
4. The final married print made from both picture negative and sound negative. When many married prints are required, they are called release prints.

Production of an optical sound film by the negative-positive process.



If you are accustomed to producing silent films on reversal stock, the above process means appreciable added expense and complication. The system is most appropriate to the production of a large number of final prints because the cost of the two negatives and the cutting copy is considerable. When this cost is spread over a large number of prints, however, the overall cost per print diminishes rapidly and after the first few copies it becomes quite low.

The first step in using a negative-positive system is the exposure of the picture on negative stock. This is developed and fixed to provide a negative which, like that from a still camera, has blacks and whites reversed. Consequently, the film which goes through your camera will be of no use for projection. This is in contrast to the reversal film which is normally used by amateurs and which is processed to provide a positive, i.e., a film in which whites are white and blacks, black.

Because of this, you can use double perforated film in a 16-mm. camera even though the married print is always made on single-perforated film. You are compelled to use single-perforated film in the camera only if it is a single-system sound camera. This records the sound directly on the same film as the picture. The high cost of such a camera places it beyond the reach of most amateurs, however, and in any event it introduces editing difficulties later on.

The negative film stock in the camera should be exposed at 24 f.p.s. since the print is projected at this speed. The higher speed provides better sound quality than is possible at 16 f.p.s. It means also that you must open your lens iris by two-thirds of a stop above the aperture you use at 16 f.p.s. Instead of *f*8 for example, you will use *f*6·3.

The Cutting Copy

It is important to keep a reversal film clean. This is especially difficult during editing as you are then obliged to handle the film a good deal and often leave it in short,

unspooled lengths. Dust, scratches and fingermarks are your enemies.

In negative-positive, they are even more objectionable since dirt on the negative appears white on the print. Moreover, the contrast of the print is higher than that of the negative and fingermarks are consequently emphasised.

This, then, is one reason why you need a cutting copy when you use the negative-positive system for sound. With this mute picture film, you can edit to your heart's content. If you cut too much out of a shot, you can even replace it, however obviously. Although this is a positive picture, it is still not the one the audiences see. Consequently a few extra splices are of no importance.

Edge-Numbering

During editing, it is the cutting copy which receives all the harsh treatment. The negative is safely spooled up, out of harm's way. Only when you are completely satisfied with the flow of edited picture and rehearsed commentary, do you touch the negative. All you have to do then is to cut and splice the negative to match the cutting copy frame for frame.

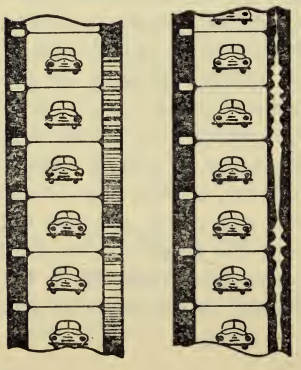
This process is greatly simplified if you shoot your picture negative on a film stock which is edge-numbered, i.e., during manufacture a number has been printed in the margin at every foot along the film. This number appears on the cutting copy, alongside the picture and forms a convenient way of identifying the negative from which a particular shot has been printed. When the shot is one of several similar "takes" this is a great help. Moreover, by aligning corresponding edge numbers on negative and print, you can tell immediately at which frame to cut the negative. A good editor often chooses carefully the precise frame for a cut and his choice should be perpetuated in the negative and subsequent prints.

The Sound Negative

In professional films, the sound usually consists of lip-synchronised dialogue (p. 129) and is recorded on a separate sound negative which is edited to match the picture negative. When the sound track consists of music, sound effects or commentary, however, you can record the sound later in synchronism with the projection of the cutting copy. Ideally the sound negative will then require no editing, but you can correct any timing errors by adding or removing parts where necessary.

You can check the sound negative quite simply by running it through any sound projector. Correctly threaded, it will sound quite normal. However, because it is a negative it is particularly susceptible to the effects of dirt and scratches. The noise reduction bias applied during recording is designed to minimise the effect of dirt on the positive. Consequently the bias, which produces slow changes in track width or density, actually emphasises any defects in the negative. So handle it with great care.

The necessity for editing of the sound negative has been further reduced by the widespread adoption of magnetic recording in many of the recording studios. Sound is recorded first on magnetic tape which can be checked by



Noise reduction bias cuts down the light transmitted by the sound track in quiet passages and so reduces the effect of dirt and scratches. These variable density (*left*) and variable area (*right*) tracks both show how the light valve has gradually re-closed after recording the loud sounds.

playback in step with the picture. Corrections are made on the tape as necessary and the sound is transferred to film only when pronounced satisfactory.

Synchronisation of the sound negative and picture can be checked quite readily by spooling them together on a common reel and lacing both films through the same projector. The sound negative is clear over the picture area and so will not interfere with projection. You should avoid lacing the picture film round the sound head, however, as it will interfere with the sound reproduction of the sound negative.

Synchronisation Marks

When you thread two films through the projector in this way, you must see that the picture and sound are correctly synchronised. The sound must reach the sound head when the corresponding picture is in the gate. The sound head is 26 frames below the picture gate and consequently the sound track must be set 26 frames in advance of the picture. If you examine a sound film closely, you can often identify particular parts of the sound track. You will then find that the recording of an impact is not printed opposite the picture of the impact. Instead, it is opposite the frame projected just over one second earlier.

You can easily adjust the synchronisation of picture and sound so long as they go through your projector as two separate films. So although the synchronisation must be correct to within two frames or better you can readily achieve this by trial and error. However, when the married print is made from your two negatives, the laboratory people will not want to determine the correct synchronisation in this way. You want a married print with the correct 26-frame advance of the sound: the laboratory needs a quick way of seeing you get it.

This is why you must put synchronisation or sync. marks on the leaders of the sound and picture negatives. You make a sync. mark by scratching two lines diagonally

across a frame and punching a hole in the centre. Make a mark of this kind about 4 feet before the start of the picture negative and another 4 feet after the end. Then make corresponding marks on the sound negative, but, of course, be very careful to mark exactly the right frame in each case.

There are two possible ways of placing the marks on the sound negative. They are:

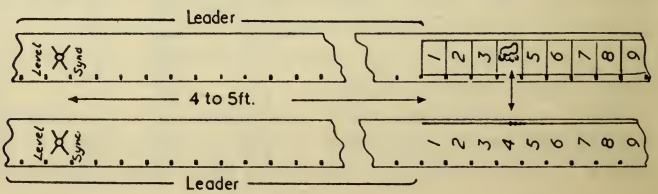
1. Level synchronisation.
2. Printing synchronisation.

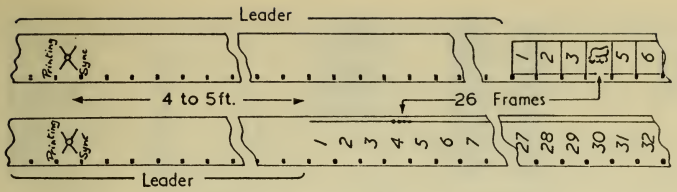
Usually either will do, as long as you leave no doubt as to which you have used.

Level synchronisation is the kind used for editing the sound track to match the picture. The sound is placed immediately alongside the corresponding picture all the way and the sync. marks are exactly level at each end of the negatives. Consequently the sound negative must be moved up 26 frames before printing in order to ensure correct reproduction from the married print.

Printing synchronisation saves the need for this adjustment. The sound negative is already advanced 26 frames before the sync. marks are made. You can do this quite easily by running picture and sound through your projector as described above. When the synchronisation is correct, run forward or back to a suitable part of the leader and put a sync. mark on each film on the frame about to enter the gate channel.

Picture and sound negatives must be provided with synchronisation marks in the form of a cross with a hole punched in the centre. If the sound track is arranged in step with the picture, the sync. marks must be labelled clearly "Level Sync."





"Printing Sync." implies that the sound track is already advanced the necessary 26 frames for normal sound projection. This must be indicated opposite the sync. marks.

It will help to avoid confusion if you use the system—level sync., or printing sync.—preferred by the laboratories to which you send your films. In any case, mark alongside both sync. marks on both films the words "Level Sync." or "Printing Sync." whichever is appropriate.

Reversal Films

It may happen that you shoot your picture on ordinary reversal film and decide later to add sound. You can then choose between:

1. Using a sound negative, or
2. Using a direct-positive recording.

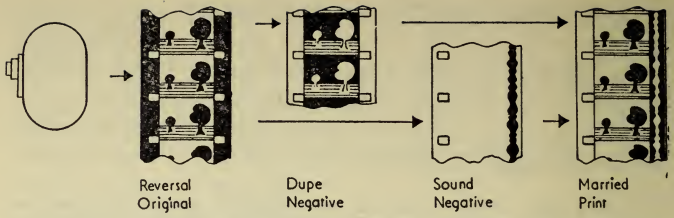
Each method has its advantages.

A sound negative adds to the cost if you require only one married print. But when several prints are needed, it is an economy because it saves time in printing.

You must take great care of the reversal original in order not to incur damage during editing. Subsequently, you get a duplicate or dupe negative made of the picture. This is a misleading term because this picture negative can scarcely be a duplicate of a negative which is non-existent!

The sound is recorded on a sound negative and the picture and sound negatives are printed on positive stock, exactly as for negative-positive except that the emulsion turns out to be on the opposite side of the print.

An objection to the method lies in the slight loss of picture definition and sound quality which accompanies

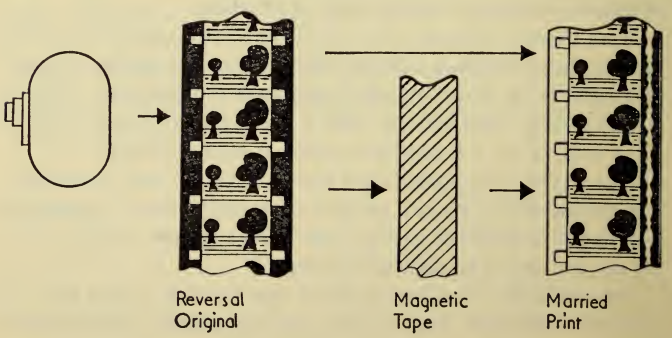


Production of a married sound print from a reversal original by means of a dupe picture negative and a sound negative.

each printing process. With good equipment, carefully operated, losses from this cause can be reduced to a low level.

Direct-positive recordings incur no such losses in sound quality because the recording is made directly on to the final copy. With this system, good results are possible on 16 mm. even at the silent speed of 16 f.p.s. As this is not the standard speed for sound films, you can take advantage of its economy only for your personal films. Even at 24 f.p.s., however, direct-positive recording can provide a substantial economy. It eliminates the need for a dupe negative and sound negative, so that the married print is the only film used apart from the picture original.

Production of a married sound print from a reversal original by first recording sound on magnetic tape.



Sound is first recorded on magnetic tape while the edited reversal original is projected as a timing guide. After recording, the sound is played back during projection and any errors are corrected.

When you are satisfied, the tape and picture original go to the laboratories for the production of a married print. The picture is first copied on to single-perforated reversal duplicating film, but the margins of the film are left unexposed. Next the same reversal duplicating film is run through a sound recorder and the sound is transferred to the film from the magnetic tape which is run in step with it. When the duplicating film is processed, therefore, you have a married print with positive picture and sound in correct synchronisation.

This is the cheapest way of producing one married print from a silent original. It is not a good system to use where you need a number of copies, however, and in this case you will resort to negative-positive methods.

Colour Films

All colour films available to the amateur are of the reversal variety and broadly speaking they are handled in much the same way as reversal monochrome films. There are, however, complications which make it a more difficult and more expensive business getting good sound on colour film.

These complications do not affect you directly as you are not handling the apparatus for printing, recording or processing. You must, however, expect colour inferior to the original, sound inferior to the best monochrome and costs a good deal higher than monochrome. If you need only a single married print, magnetic sound on stripe scores heavily on all these points (p. 97).

Blooping

One advantage of sound on film is its permanence of synchronisation. If you damage the film and have to cut out

Splices can be rendered silent by painting an oblique opaque band across the sound track with blooping ink. The diagonal splice (*right*) requires slightly less blooping than the straight splice (*left*).

a few frames, you necessarily cut the same length from the sound track as from the picture. On projection, the synchronisation is lost only for about one second while the splice is between the picture gate and sound head. This is such a short interval that the temporary loss of synchronisation will often pass unobserved.

A neat splice will not generally be noticeable on the screen, but unless you "bloop" it, it will produce a loud "plop" as it passes the sound head. Whenever you splice a sound film, whether it is a married print or a sound negative, you should therefore bloop each splice. This involves painting the track with an opaque blooping ink so that the full width of the track is covered at the splice. Before and after the splice, the width of track covered should decrease gradually so that none of the track is obscured beyond one frame from the splice. A splice blooped in this way will pass the sound head silently.

Using Magnetic Recorders

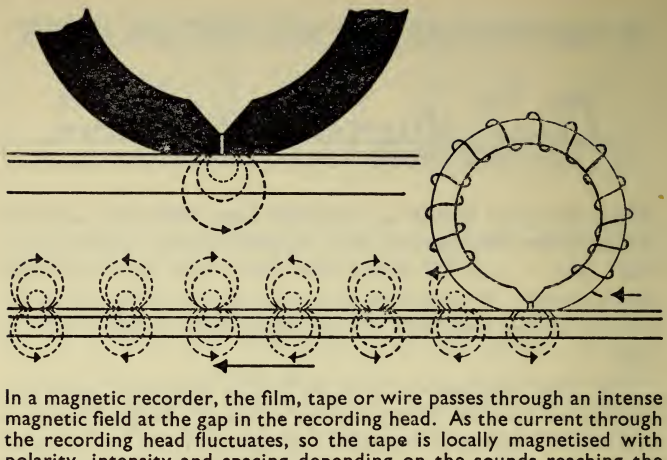
When first you handle a magnetic tape recorder, you will probably be surprised at how simple it all is. Usually it is built into a case of about the same size as a portable gramophone. A hinged lid gives easy access to the two reels of tape which generally are arranged horizontally, side by side.

The tape measures $\frac{1}{4}$ inch wide and just over $1\frac{1}{2}$ thousandths of an inch thick. In this country, the popular size of a reel is 7 inches in diameter and carries 1,200 feet of tape. This lasts half an hour, running at the popular standard speed of $7\frac{1}{2}$ inches per second. Only half the width of the tape is used at one passage, however, and by interchanging spools you can run the tape back again and record for a further half hour. This type of machine is called a twin-track recorder.

The Mechanism

A capstan roller draws the tape over a recording head consisting of a coil of wire wound round an iron core. This forms an electromagnet, in the core of which there is a narrow gap only half a thousandth of an inch across. Usually the gap is filled with brass and is barely visible. Nevertheless the force of the electromagnet is concentrated along the line of the gap and the iron oxide is magnetised locally as it passes over.

In addition to the recording impulses, the recording head is supplied with a supersonic bias. This is an electric current alternating about sixty thousand times a second. Its job is to "shake up" the coating on the tape so that the recording impulses can more readily affect it. Without the bias, the



In a magnetic recorder, the film, tape or wire passes through an intense magnetic field at the gap in the recording head. As the current through the recording head fluctuates, so the tape is locally magnetised with polarity, intensity and spacing depending on the sounds reaching the microphone.

magnetisation of the tape would not be proportional to the recording impulses.

When you want to play back a magnetic recording, you have only to turn a selector switch and pass the tape a second time through the same machine. On most machines, the electromagnet which previously recorded the impulses now serves to detect them. It is then called a record/playback head, or R/P head. As the magnetised portions of the tape pass by they induce in the record/playback head impulses which are feeble replicas of the original impulses. The amplifier which was first used for recording serves now to amplify these feeble impulses until they can operate a loudspeaker.

Erasing

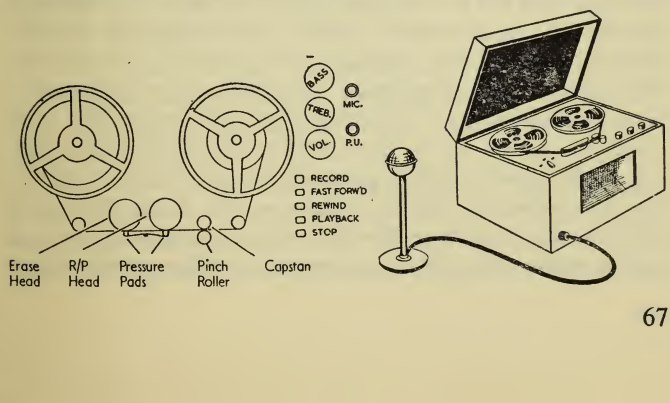
Very often, the record/playback switch fulfils another purpose besides that of transferring the record/playback head from the output end of the amplifier to the input. It brings an erase head in or out of operation. As its name

implies, the erase head removes from the tape any earlier recordings before they reach the record/playback head. Obviously, you do not want the erase head to be operative when you are playing back the tape and it is therefore arranged to work only during recording.

There are two ways in which the magnetic recordings can be erased. The simpler consists of passing the tape over a small permanent magnet. In effect, this magnetises the whole tape uniformly to the maximum extent. The playback head responds only to variations in the degree of magnetisation of the tape and so reproduces no sound from a uniformly magnetised tape. In practice, however, small variations in the uniformity of the tape will produce spurious impulses in the playback head. These may be audible on playback as a hissing sound.

For this reason, the majority of recorders use another kind of erasure. This is effected by an erase head which is very similar to the record/playback head, but has a much wider gap. The erase head receives no recording impulses: only a high frequency current similar to, but stronger than, the supersonic bias. The stronger agitation so produced acts

A typical domestic tape recorder. Tape leaving the feed reel passes the erase head and then the record/playback head. The tape is drawn past the heads at a constant speed by the capstan against which it is held by a pinch roller. Recordings can be made either from a microphone or direct from a radio or gramophone pick-up.



on the coating for long enough to destroy every trace of earlier recordings. The tape is left completely demagnetised and is therefore free from hiss.

The Controls

On a modern tape recorder the controls to achieve all this are few and simple. Although some relate to the amplifier and others to the mechanism, they are often grouped together and interlocked to reduce the risk of mistakes. For example, the record/playback switch on the amplifier is often combined with the control which stops and starts the tape drive.

Almost all popular recorders will run at a tape speed of $7\frac{1}{2}$ inches per second, but many will operate also at alternative speeds.

Changes from one speed to another may be produced in a variety of ways. Sometimes a knob or button provides immediate control. On other machines, it is necessary to interchange capstans or transfer a belt from one pulley to another. At the opposite extreme are those recorders in which the speed is infinitely adjustable over a certain range.

Threading and Connecting

Threading a tape recorder is even simpler than threading a projector, because there are no sprockets or claws to worry about. On the other hand, since the reels are reversible, you must put the full reel of tape right way up on the feed reel spindle. As you unwind a little tape and pass it over the recording head to the capstan, the coated side of the tape must face the recording head. Any felt pressure pads should bear on the shiny or uncoated side of the tape. On some machines, a line on the base plate indicates the path of the tape and makes threading particularly easy. Many recorders also use drop-in threading; you have only to lay the tape in a slot before attaching the free end to the take-up reel just as you would with a film on a projector. Then, when you set

the control to "playback" or "record", the pressure pads and pinch roller close on the tape simultaneously and it feeds through the machine at a steady rate.

On most machines of this type, you have only to operate a button or switch to move the tape rapidly backwards or forwards to another part of a recording. In other designs, the tape must first be lifted clear of the recording head and capstan so that it can pass directly from one reel to another.

Before you first connect the recorder to the mains, make sure that the supply is suitable. Nearly all recorders are intended for a 200–250 volt A.C. mains supply. (Details of the mains supply are marked on the electricity meter.) If you have an A.C. supply of less than 200 volts, get a step-up transformer to provide 230 or 240 volts for the recorder. If you have a D.C. supply, or none at all, you must get a battery model which uses a spring motor to drive the tape.

You will probably master the mechanical controls of your recorder in a few minutes. However, you can learn only by experience how to use the amplifier controls. These comprise a volume control and a tone control or controls. Voices, microphones and loudspeakers differ so greatly that it is useful to have separate controls for the bass and treble frequencies.

Recording Level

The setting of the volume control is important, not only during playback when you can hear the output of the amplifier, but also during recording when the loudspeaker is often inoperative. If you record at a low level, i.e., with the volume turned down, you may not be able to obtain sufficient volume during playback. Alternatively, when you turn up the volume for playback, a weak recording is largely obscured by hum.

On the other hand, it is equally important not to record at too high a level. There is a limit to the extent to which the tape can be magnetised. When this is reached, the tape suffers from saturation and an increase in the current

through the recording head no longer produces a proportionate increase in the magnetisation of the tape. As a result, the recording is distorted and no manipulation of the controls during playback will produce a satisfactory result.

To give warning of saturation, many recorders possess a recording level indicator. This may be a "magic eye" or a neon lamp which flashes when the recording impulses threaten to saturate the magnetic coating. When recording, adjust the volume so that the indicator flashes occasionally on the louder passages. Then the recording is amply loud enough to avoid playback hum, but below the distortion level.

Even the recording level indicator may be misleading if you use a brand of tape for which the recorder was not designed. Some tapes saturate more readily than others. Some give a higher playback signal and some are more difficult to erase than competitive makes.

Test Recordings

If your machine has no recording level indicator, you must determine the appropriate level by experiment. When you are recording speech this is quite simple. Just speak into the microphone at the distance and volume you intend using. Then, while recording your voice, you can describe what you are doing with the controls.

It is useful to provide the knobs with numbered scales. Alternatively mark an arrow-head on each and describe their positions in terms of a clock dial. When an arrow-head is pointing straight up, it is "at 12 o'clock". When it is pointing to the right, it is "at 3 o'clock", while "6 o'clock" means it is pointing straight down.

Your test recording will sound something like this:— "This is the start. I am speaking in a normal voice about a foot from the microphone. The volume is full up, which means the arrow-head is at 6 o'clock. I am now going to turn it down to 5 o'clock. . . . The volume is now 5 o'clock. I am just going to say a few words on this setting and then

turn the volume down to 4 o'clock. . . . The volume is now 4 o'clock . . .", and so on.

You can play this back several times with different settings of the amplifier controls to decide on the best combination for recording and playback. A similar procedure will determine the optimum microphone distance and the best setting of the tone controls. These two factors are to some extent interdependent. If you speak very close to the microphone, the lower frequencies are emphasised. You can sometimes off-set this by adjusting the tone control. Try to adjust all your recordings, speech or music, so that you can play them back successfully with a single setting of the volume and tone controls.

Remember that the apparent tone quality on playback depends partly on the volume. Speech which is satisfactory at low volume may well sound boomy at the higher volume you use for accompanying films. So do your playback tests at this volume.

When you have found the best settings of the controls for a particular purpose, it is a good plan to make a note of them. Then you can use them on future occasions without the necessity for further experiment.

These settings become part of the "know-how" you will soon acquire concerning your equipment. This should also include measures to prevent irritating mechanical mishaps. For example, tape has an unpleasant habit of spilling off the side of a full reel. So learn to hold it in place with the finger of one hand while threading up with the other. Some wire recorders are difficult to thread, but you can facilitate matters by tying a couple of feet of fishing line to the beginning of the reel. In any recorder it is best to take up all the slack before switching on. This will eliminate any snatch which may stretch or snap the tape or wire.

Splicing

On a wire recorder you can repair a break by simply knotting together the two ends. You lose some of the

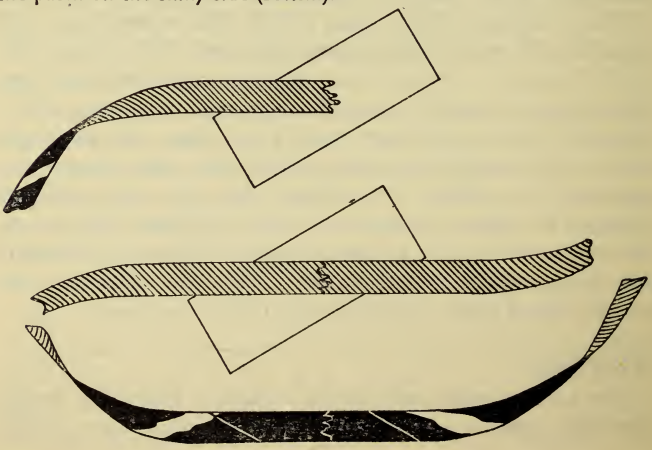
original recording, however, and can hear the join passing the playback head. Also it may produce speed irregularities, or wow, later in the reel.

A break in magnetic tape can be repaired beyond audible detection. You have only to butt the torn ends together carefully and apply a piece of self-adhesive tape diagonally across the back. Trim off the surplus self-adhesive tape, and the recording can be played without any evidence of the patch.

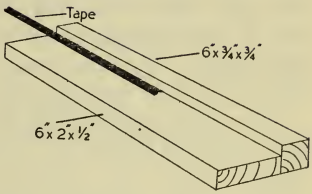
When you want to cut and join two pieces of tape, cut the end diagonally. This ensures a smooth passage through the recorder and a good transition from one recording to the other.

If you intend making a recording after splicing the tape, it is a good plan to make a lap joint with splicing cement. This is suitable only for plastic tape. Carefully made, the

Broken magnetic tape is readily and neatly repaired with cellulose adhesive tape. Lay one end of the broken tape obliquely on the adhesive tape (*top*) with the base (*shiny*) side down. Carefully butt and align the other end (*centre*) before pressing it on to the cellulose tape. Trim off the surplus mending tape so that the repair is distinguishable only by the patch on the shiny side (*bottom*).



To trim tape for splicing (*above*), place the two ends in contact, shiny side to dull. Then make one oblique cut across both tapes. Provided the cut is straight, the oblique ends will butt perfectly with the tapes in alignment. A simple guide block (*right*) makes splicing much easier.



cemented splice is as good as unbroken tape. Too little cement produces a weak splice, but too much causes cockling of the tape.

Since a splice must leave the tape in good alignment, a simple guide block is a great help, no matter which method you employ. This you can make readily from two pieces of hardwood. A piece about $6 \times 2 \times \frac{1}{2}$ inch forms the base on which you lay the tape. A second piece of wood, about $6 \times \frac{3}{4} \times \frac{3}{4}$ inch is glued or screwed to the side of the first and you push the tape against this to hold it straight.

Choice of Tape Speed

Because the tape is independent of the film, you can choose any nominal tape speed which provides an acceptable compromise in cost, quality and convenience. The majority of domestic recorders run at $7\frac{1}{2}$ inches per second. At this speed, good equipment gives quality comparable with good disc recordings. So if you are drawing on discs for music and effects, there is little point in using a tape speed above $7\frac{1}{2}$ inches per second. On the other hand, you can halve

tape costs by using a speed of only 3¾ inches per second. This involves some loss of quality in music, but can still provide good speech reproduction suitable for commentaries.

Before settling for either of these speeds, you should consider the merits of a third speed: 4·8 inches per second. This is high enough to give good music, low enough to offer some economy. But its real merit appears during editing. Running at 16 f.p.s., 16-mm. or 9·5-mm. film has a linear speed of 4·8 inches per second. So if you cut a shot out of your film after recording sound on tape, you have only to cut the same length from the tape to preserve synchronism. With 8 mm., the film runs at 2·4 inches per second, so you have to cut out twice as much tape as film.

Few, if any, commercial recorders run at this speed. When the capstan is driven by a spring belt, however, it is a fairly simple matter to provide the driving motor with a smaller pulley to reduce the speed from 7½ to 4·8 inches per second.

Start Marks

Whichever speed you use, and however you control it, you must take care to start your projector with picture and sound in step. The audience will not be well impressed if you have to make people scurry around the screen until the picture catches up with the sound.

You can get over this quite simply by marking both film and tape near the beginning at a point where they should be in step. The film is best marked by splicing a length of black leader before the first title and punching a round hole in the appropriate frame. Mark the corresponding point on the tape by a piece of white self-adhesive plastic tape on the shiny side. Alternatively, use the more common transparent tape over a slip of white paper.

Do not try to start projector and recorder simultaneously. It is far more satisfactory to record a short piece of music on the tape to precede the film. Have the projector already threaded with the marked frame in the gate. Then switch it

on as the marked part of the tape approaches the capstan.

If your synchronising system does not control the projector speed automatically, get an assistant to do the job for you when recording. You will then be able to watch the screen for the cue from which to time commentary and music.

Timing

There are several ways in which you can ensure that the recording synchronises with the film.

1. By recording while the film is projected.
2. By preparing a timed cue sheet and subsequently recording without using the projector.
3. By recording a pilot commentary and replacing this piecemeal.

These three systems give different results.

Although it may appear the simplest method, recording during projection is the most difficult to operate successfully. It is very difficult to avoid recording the noise of the projector. If you go to the trouble of putting the projector in another room, you cannot so readily signal between projectionist, recordist and commentator.

Furthermore, it is not easy to record, in a continuous run, the sound for a quarter of an hour of film, or more. Unless you have rehearsed things carefully, you may miss a cue or find yourself with the wrong disc on the turntable. It is also nerve-racking work trying to read a commentary for long periods with correct inflection and timing.

Working from Cue Sheets

The above criticisms are removed if you time the recording from a cue sheet instead of projecting the film as a guide. A cue sheet for this purpose is generally similar to that on p. 28. However, instead of listing the shots at which the sound must be changed, you indicate the times of the changes.

Project your film first at the correct speed and measure times in minutes and seconds from the start. When you have entered these times on the cue sheet, you have no further need of the projector.

Your cue sheet may begin something like this:

IF IT BE THUS TO DREAM...

Time (seconds)	*Scene*	*Music*	*Commentary*
0–15	Main titles	Perpetuum Mobile (Strauss)	—
15–40	Beach scenes—sun, sand, sea and bathing beauties.		"This is how we always dream of our holidays —days on the beach basking in the sun and in good company."
		Perpetuum Mobile (Strauss)	
40–60	Deserted beach on cold day. Family seeks shelter behind breakwater.	Desolation (Patou)	"Somehow things never work out that way".

From the start mark on the tape, it is a simple matter to record the introductory music—Perpetuum Mobile—for 15 seconds.

Then stop the recorder, set up the microphone, and rehearse the first passage of commentary. When you are satisfied, record it. If necessary, make several attempts until you get a good recording.

Now record some more of Perpetuum Mobile. Since the commentary took about seven seconds, you strictly require only about 18 seconds of music to reach the 40-second point. However, there is no harm in giving good measure—say 25 seconds.

Each time you start the tape, allow about one second for the speed to stabilise before speaking or fading in music. Otherwise recordings will be marred by a wail at the start.

To avoid accumulating timing errors, play the tape back now, and time it as you run through to the 40-second mark. Then you can stop the recorder and get ready for recording the second passage of commentary.

Working in this way, you record no projector noise, since the projector is not running. You can rehearse, record and correct each piece of commentary separately. You can also change discs at leisure since the tape is arrested in the meantime.

On the other hand, even this method is unsuited to complicated recordings of considerable length. If you want to avoid cumulative timing errors, you must repeatedly play through from the start to ensure that the timing agrees with the cue sheet. Moreover, because they were timed with a watch, neither the cue sheet nor your recording times are likely to be accurate to better than one second. Yet in some cases you may want to synchronise more accurately than this.

Pilot Commentaries

You can combine the advantages of both the previous methods, without their disadvantages, by first making a pilot commentary. While projecting the film at the correct speed, you record a spontaneous commentary describing each shot in turn. This is for your own use only and bears little relation to any commentary the audience will eventually hear. In the example already quoted, the pilot commentary would begin:

Title, "Family Circle Films Present—"
Title, "If it be thus to dream . . ."
Fade-out.
Fade-in. Clouds, tilt down to beach.
Girl throws beach ball.
Other girl misses it.
Dad jumps up.
Dad returns the ball.
Fade-out—*and so on.*

The pilot commentary will, of course, be mixed with projector noise. This does not matter at all provided the

recording indicates clearly which shot accompanies any part of the tape. Once you have made a pilot commentary which fulfils this purpose, you can put away the projector.

The next step is to replace the pilot commentary piecemeal with the music and commentary intended for your audience. This is how you do it.

First run the tape through the recorder until your recorded voice begins "Title, Family Circle . . .". Stop the recorder and turning the reels by hand "inch" the tape back until you have the beginning of the word "Title" opposite the record/playback head. Now mark the tape clearly at a convenient point. If you cannot mark it at the record/playback head the capstan will do. You can use any convenient position for reference, provided you always work to the same scheme.

The mark should be on the back of the tape—the shiny side in the case of plastic tape. A ball-point pen will serve at a push, but you will get on better with a special wax crayon made for marking glass and china.

When you have marked the tape to correspond to the beginning of the titles, you can play through to the cue for the first piece of commentary. This is where you have recorded "Fade-in, Clouds . . .". Again stop the tape and mark it opposite your reference point.

Now rewind the tape, and get everything ready to record the music. Start the recorder and then fade-in Perpetuum Mobile as the first cue mark passes the reference point. Watch the tape carefully and when the second cue mark goes by, fade the music out. Allow the tape to run on for about three seconds before stopping the recorder.

If you now play through your tape, you will find that the early part of your pilot commentary has been erased and replaced by music. This is on the tape corresponding to the titles. The first three seconds following will be silent now and thereafter comes the rest of your pilot commentary.

When you are satisfied with the music recording, rub out the first mark on the tape with your thumb and put a fresh

mark where the second piece of music is to finish. This is at the end of "Dad returns the ball. Fade-out".

You have once more two marks on the tape. Set the tape with the first of these marks an inch or two beyond your reference point and switch to "record". Provided the tape is stationary, you impress little or no switching noise on the tape by doing this. Set the volume control, start the tape and after allowing a second for the speed to stabilise, speak the first passage of commentary into the microphone. At the end, turn down the volume and stop the tape within two or three seconds.

Now switch to "playback" and find the end of the commentary you have just recorded. Starting from here, record the second passage of music as far as the second of the two marks on the tape.

Continuing in this way, you can gradually replace all your pilot commentary by the music and commentary you want the audience to hear. You can rehearse separately each passage of commentary and time it to a fraction of a second, if need be.

Some films may call for split-second timing over a considerable period. An example arises in the quick cutting used to build up tension. Recording the pilot commentary for such a sequence is not easy unless you know the script by heart. To provide accurate timing, you must provide the first word of description immediately each new shot appears on the screen. More likely than not you will hesitate at some of the shots and your pilot commentary will lag behind the picture. To avoid this, get an assistant to tap an object near the microphone at the start of each shot. It will not matter then if you hesitate or even occasionally omit to describe a shot. When you make the final recording, you use the "taps" as timing marks; your commentary identifies the shots to which they relate.

Sound Mixing on Tape

When you have mastered the rudiments of recording commentary and music on tape, you will want to add the finer touches. For many of these you need some way of recording two or more sounds on the same piece of tape. For example, you may want to mix slowly from the sound of a waterfall into a piece of music. This is clearly a much smoother transition than the fading-down of one followed by the fading-in of another.

Alternatively, you may have a sound effect for the engine of the "Skylark" and you want to get it on the same piece of tape as the sound effects of waves and seagulls. Then again you may decide to record a commentary over a background of music rather than in spaces left or made for it. In many ways this is the most exacting case of all, so we will discuss it in detail. The same methods can be applied to each problem.

Just as there are several ways of recording a synchronised commentary, so there are various ways of mixing sounds on tape.

1. You can mix together the outputs of microphone and pick-up, or of two pick-ups, and record them simultaneously.

2. You can record one sound on tape with the correct timing. Then run it through a second time and record the second sound without completely erasing the first (p. 82).

3. After recording the first sound, you can play it back, mix in the second sound and re-record the two together on the other half of the same tape.

4. By a variation of the pilot commentary technique (p. 77), you can remove half the width of the track carrying one sound and replace it with a recording of the second

sound. Then the final split track recording consists of two tracks, each only half the normal width. (On a twin-track recorder, therefore, you have got two quarter-width tracks down one side of the tape.) When you play back the tape, the record/playback head reproduces both these narrow tracks at once.

As before, the apparently simple method proves awkward to use. The others, though more involved to describe, are easier to handle. Let us consider each in turn.

Mixing from Gramophone Records

If two gramophone records can be mixed for mood music from discs, why should you not record the result on tape? There are plenty of reasons. First of all, it presupposes you have two turntables and pick-ups. But unless you advanced to tape through the twin-turntable-and-disc system, there is no reason why you should have.

Even if you are fortunate in having the necessary equipment, however, you will still have to find at least one assistant to help you use it. One of you will have a full-time job handing two turntables, pick-ups and volume controls. The other will manage the tape recorder and keep an eye on the projector speed.

This arrangement works well enough until you want to use a microphone for one of the sounds. Then, as we have seen already, you come up against projector noise troubles. Even more pressing is the question of adjusting correctly the relative volumes of speech and music. If you try to listen to the result on a loudspeaker you will have trouble with microphone howl. To overcome this you must have the speaker in a separate room, or else use headphones to check the balance.

As a third alternative you can mark scales against the various controls (p. 26), and determine the right settings by preliminary experiment. No matter which way you do it, the procedure becomes much more cumbersome than it appeared at the outset.

Part Erasing

When you record on a previously used tape, the erase head is normally energised to remove the earlier recording. If you disconnect the erase head, or somehow arrange that the tape does not come in contact with it, the original recording is partly, but not completely removed. The partial erasure is produced by the supersonic bias (p. 65) in the record/playback head. It agitates the magnetic particles just as it would in the erase head, but it does not act long enough or strongly enough to effect complete erasure.

One method of mixing sounds on tape makes use of this principle. First of all record one sound, music for example. Then rewind and play back the tape until you reach the point at which you are going to add the second recording, perhaps a passage of commentary. At this stage, place a slip of paper over the gap in the erase head and fix it there with self-adhesive tape. This will not interfere with the passage of the magnetic tape, but will hold the magnetic tape clear of the erase head far enough to restrict the amount of erasure. You can now switch to "record", record your commentary and at the end switch to "playback" once more. When you reproduce the whole recording, you find that where you have superimposed the commentary, the music falls in volume because it has been partly erased.

This system is easy to use, but it suffers from two drawbacks. Partial erasure affects the higher frequencies more than the lower ones and the music, therefore, sounds muffled and "woolly" where it accompanies the commentary. In many cases this may be useful since it ensures that the commentary is not rendered unintelligible. On the other hand, it can be a nuisance when you want to mix two sounds without modifying either.

The big difficulty is that you cannot make corrections to passages of commentary superimposed on music. If you make a slip in your commentary you have to erase the tape completely in order to remove the offending passage,

removing also that part of the music which accompanied it. If you try to replace only this section of the music, you will be left with a discontinuity at beginning and end of the new recording. You must choose between replacing the whole piece of music and recording the music passage on a separate tape which can be cut and spliced to produce a perfect match.

Re-recording all the music is particularly undesirable if it is a long piece on which you have already made several successful superimpositions. Cutting-in a new piece of tape is a very exacting job and even less attractive as a solution.

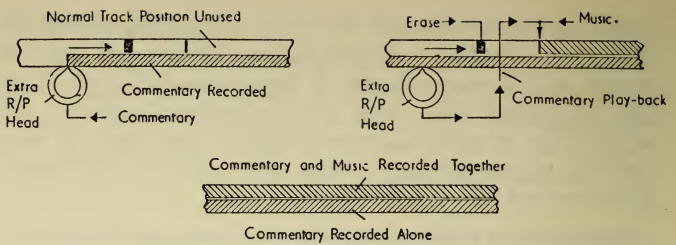
Twin-Track Mixing

With a twin-track recorder (p. 65), there is another way of superimposition which overcomes these difficulties. Although it is more convenient to use, this method involves some modification of the recorder.

First of all, you need an additional record/playback head. These are readily obtainable as separate components. Mount it on the recorder, upside down if need be, so that it operates on the half of the tape you are not normally using.

Starting with a completely erased tape, use the new record/playback head to record all the commentary in correct timing with your film. Because the recording is on the "wrong" half, it will play-back in reverse if you use the normal record/playback head for reproduction. Don't worry about that—you are not going to, just yet.

Now you rearrange the connections so that the new record/playback head feeds the microphone input of the amplifier while you supply music (e.g., from discs) to the pick-up input. Then if you run through the tape again, commentary from the tape can be mixed in the amplifier. The output can be monitored on a loudspeaker with no risk of the microphone howl which would occur with a live commentary. So by simple adjustment of volume controls, you can adjust the balance of speech and music all the time.



One method of mixing commentary and music on tape is twin-track recording. The commentary is recorded first (*top left*) on one side of the tape. Later (*top right*) it is played back, mixed with music in the amplifier and re-recorded on the other side of the tape. On the completed recording (*bottom*), the side carrying the commentary alone can be erased later.

While you are doing this, the combined speech and music are being recorded by the normal record/playback head on to the unused standard side of the tape. So at the end of the process, you have a combined recording in the normal position while still retaining the preliminary recording of commentary alone on the "wrong" half. If the combination of speech and music is not completely satisfactory, you can repeat the process until it is. When you are satisfied with the result, you can reverse the reels to erase the "wrong" half and use it in the normal manner for some other purpose.

This method has the advantage of allowing you to perfect your commentary independently of the music. Any mistakes can be erased and corrected in the usual way without any complications. The mere knowledge that this is so, often serves to put the commentator at his ease and so contributes to a good performance which may not need revision.

To many enthusiasts, the electrical aspects will present a difficulty. They are a simple matter to anyone familiar with radio sets, so call in the assistance of a radio engineer if necessary. Tape recorders vary considerably in detail: some include the necessary provision for mixing inputs, others do not. On some you can listen to what you are recording, but often you cannot.

Split-Track Mixing

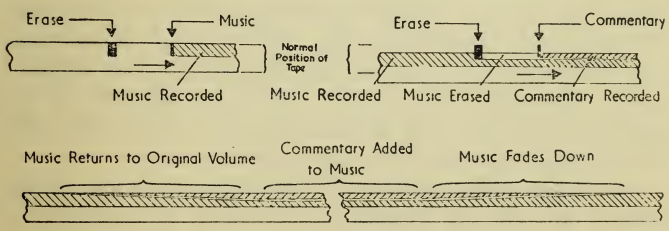
Instead of partly erasing the whole width of the music recording as in twin-track mixing, you can completely erase part of the width. What is left is then just as good as before, but gives a lower volume on playback. On the part-width of track which you have erased, you can record the commentary. If you make a slip, you can erase the commentary and replace it without affecting the recording of music.

This system requires no electrical alterations. But since it is operated mechanically, it is more readily applicable to some recorders than others, depending on their mechanical design.

First of all record all the music. Do this at the level required for the passages without commentary. Even where the commentary is to be added, do not fade down the music.

After that, play through the tape until you reach the point at which you are going to add a passage of commentary. Stop the recorder here and displace the tape (or the two heads) sideways by one-half of a normal track width. On a single track recorder, shift the tape (or heads) by $\frac{1}{8}$ inch up or down. On a twin-track machine, the displacement must be only $\frac{1}{20}$ inch.

No elaborate equipment is needed with the split-track method of mixing commentary and music. Music is recorded (*top left*) in the usual way. Later (*top right*) the tape is partially displaced so that half the recording may be erased and replaced by commentary. By gradual movement in and out of the displaced position, the recording of music is faded down before the commentary (*bottom*) and up again at the end.



On some recorders you can readily seat a piece of bent metal near the heads and capstan so that the tape will run in the displaced position. During initial experiments, two stacks of coins can even serve this purpose. Just where and how you guide the tape depends on the mechanical lay-out of your recorder. See at which points the tape is normally guided at the edges. Then place your new, temporary guides before and after these points. The displacement of the tape at the erase head should be minutely greater than that at the record/playback head. You will see why very soon.

When you have installed the guides to hold the tape in the displaced position, switch to "record-erase" and record the passage of commentary.

As the tape goes over the erase head, only half the width of the original recording (of music) is removed. The other half is not affected because it is shifted to one side of the erase head gap. Immediately afterwards, the newly erased part of the tape goes past the gap of the record/playback head and so commentary is recorded on this part of the tape. Once again, however, the remaining part of the original recording does not go over the gap and so is not affected.

At the end of this superimposition, you can usefully increase the tape displacement until the two heads are no longer covered at all. This means that the replaced width of the music track diminishes gradually until the full width remains.

When you play back the tape in the normal way, the record/playback head covers both part-width tracks. The amplifier output therefore contains a mixture of speech and music, the relative volumes depending partly on the amount by which you displaced the tape. At the end of the commentary, the volume of the music returns gradually to its original level. The speed with which it does this depends on the speed at which you slid the tape sideways off the erase and record/playback heads after the superimposition.

As in the other method of superimposition by partial erasure (p. 82), the reduction in the level of the music is

effected automatically when the commentary is added. The advantage of the split-track method, however, is that you can alter the commentary without affecting the music. If you make a slip in one passage of commentary, you have only to repeat the superimposition process. Then the unsuccessful recording of speech is erased and replaced by a new recording and the background music is not affected. This is why you should arrange for the erase head to operate over a slightly greater tape width than the recording head. This ensures that unsuccessful recordings will be completely erased when you use the same tape displacement at each attempt.

Once you have mastered the principles of split-track mixing, you can extend the method to the combination of more than two recordings. You can, for example, record the sound of waves in the normal way and then, by displacing the tape by three-quarters of a track-width, replace this proportion of the width by a recording of seagulls. Next you can reduce the tape displacement to a half-width of the track, erase the seagulls from this part and replace them with the chug of a motorboat. Finally, you reduce the displacement to a quarter-width of a track and replace half of the motorboat recording by the skipper's voice. This process builds up a sound picture of waves, seagulls, motorboat and skipper. Each sound is carried by a track only a quarter the width of a normal recording. Consequently, although they are actually separate on the tape, you hear all four sounds at once during playback.

Synchronising Tape and Wire

We have seen already that magnetic tape is a cheap and convenient medium for recording commentaries, music and sound effects. We have seen also that it is the most difficult system with which to achieve perfect synchronisation. This is because, having no perforations, it must be driven by friction rollers. Therefore cumulative errors arise due to slippage and creep at the capstan and the dimensional changes of the tape. Similar problems arise in wire recording.

When recording a commentary, precise synchronisation is not always essential. Careful scripting enables you to accept relatively large errors in timing. On the other hand, if you *must* refer to a particular shot, you can seldom accept errors exceeding two seconds.

You therefore need some method of relating the speeds of film and tape or wire. Then, even if they do not remain perfectly in step, they will at least remain approximately synchronised.

Synchronising systems are of three kinds, each of which may be automatic or may require manual control of the projector speed.

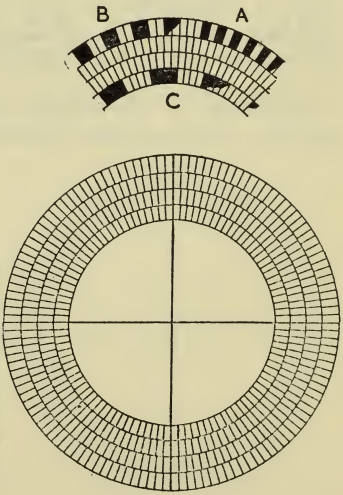
1. The projector speed is constant or synchronised to the mains.
2. The projector speed is governed by capstan speed.
3. The projector speed is governed by marks on the tape or wire.

Of these, the first system is the easiest to apply, but only the last gives perfect results.

Synchronisation from the Mains

An exactly constant projector speed will give accurate synchronisation only if the speed of the magnetic recording is always the same. In the majority of tape recorders, the capstan is driven by an induction motor. The speed of this varies with mains frequency and, to a lesser extent, with mains voltage. On the other hand, the governed-speed motor in a sound-on-film projector may be influenced primarily by temperature. So what you record and reproduce successfully one day may not keep in step next time you try it. This may be because the magnetic recorder speed has changed though the projector speed has not.

A few sound-on-film projectors use an induction motor instead of the more usual mechanically-governed type. This behaves in much the same way as the recorder motor, and so gives rather better synchronisation. When the mains frequency rises, the speed of film and tape (or wire) increases in almost the same proportion and they keep fairly well in step.



By painting in alternate spaces, as at A, you can use these patterns to provide stroboscopes of 64, 60, 56 and 52 bars, reading from outside to centre. By painting in alternate pairs of spaces, as at B, you get 32, 30, 28, and 26 bars. Painting in alternate groups of four spaces, as at C, you can use the same patterns to provide 16, 15, 14 and 13 bars.

With a silent projector, you can get comparable results by careful operation of the speed control knob. Stick a stroboscopic disc on the side of one of the sprockets and illuminate it with a neon lamp. If you adjust the speed control to keep the stroboscope bars apparently stationary, then the speed will be proportional to the mains frequency. A rise in frequency will accelerate the recorder motor. It will also make the stroboscope pattern appear to slip backwards. When you re-set the speed control to counteract this, the film and tape speeds will be substantially in the correct ratio once more.

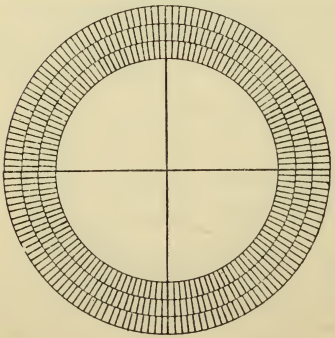
You can calculate the number of stroboscope bars by using the equation on p. 22. However, the table below gives the number required in the most common cases.

STROBOSCOPES FOR PROJECTORS
(For 50-cycle mains only)

Nominal Speed		*Disc on flywheel*	*Disc on sprocket with t teeth*				
			t=8	*t=10*	*t=12*	*t=14*	*t=16*
Nominal	No. of bars	6	50	62	75	87	100
16 f.p.s.	Actual f.p.s.	16·7	16·0	16·1	16·0	16·1	16·0
Nominal	No of bars	4	33	42	50	58	67
24 f.p.s.	Actual f.p.s.	25·0	24·2	23·8	24·0	24·1	23·9

On 16-mm. projectors, count only the teeth on one side of the sprocket.

Watching a stroboscope continuously is a tedious business. The projector speed tends to rise as the machine



Used in the same way as those shown on page 89, these patterns provide stroboscopes with (A) 76, 72, and 68 bars; (B) 38, 36 and 34; and (C) 19, 18, and 17 bars. Intermediate numbers can be obtained by cutting along a radius and lapping to form a shallow cone with an overlap of one, two or three bars and spaces, as necessary.

warms up. Also the speed changes slightly whenever a splice passes through the gate. You must therefore readjust the speed at frequent intervals and you get little opportunity to enjoy your own films.

A synchronous motor keeps the speed constant. But it must drive your projector through gearing: a belt drive always slips to a slight extent. It is not a simple matter to replace your projector motor by one of the synchronous type. A better plan is to control the projector speed from the recorder.

Synchronisation from the Capstan

The capstan of a magnetic recorder should run at a steady speed. If it does not, the pitch of the reproduced sounds will fluctuate or wow in a manner disastrous to music. On the other hand, the capstan speed is seldom constant. In a tape recorder, it depends not only on the mains voltage and frequency, but also on the tape tension at the feed and take-up reels. As the spool diameters change, so do these tensions. Consequently there is a gradual change in capstan speed throughout a reel. This does not usually matter provided the same thing happens each time you use the tape. But if you add some tape to the reel, or remove some from it, you will alter the tensions and thus the capstan speed at a given part of the tape.

Used in the same way as the others, these patterns give (A) 48, 44 and 40 bars ; (B) 24, 22, and 20 bars; and (C) 12, 11 and 10 bars. The three sets of patterns therefore enable you to produce a stroboscope with any number of bars from 10 to 76, inclusive.

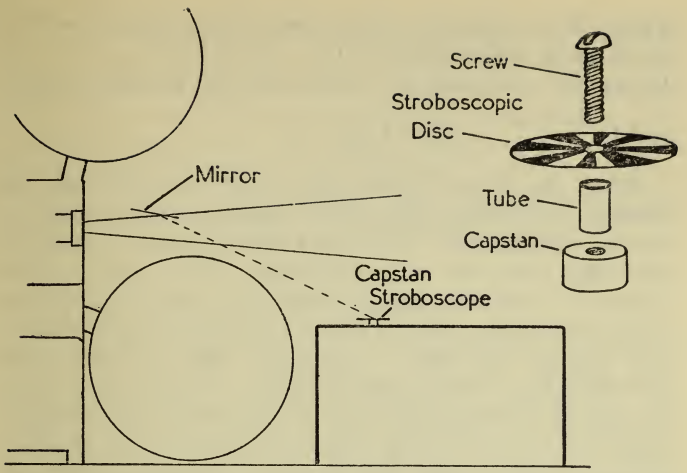
If the recorder uses friction clutches on the two reels, the tape tensions will vary as the clutch surfaces wear. However, most recorders use separate torque motors to drive the two reels, one restraining the feed reel and the other driving the take-up. With this arrangement, there are no friction clutches, but mains variations will affect the motor torques and hence the tension on the tape.

You can largely eliminate all these causes of poor synchronisation by controlling the projector speed from the capstan speed. You can most readily do this by fitting a stroboscopic disc to the capstan spindle. Then, instead of lighting it by a neon lamp, you use part of the projector light output. This flashes rapidly due to the action of the shutter, and by adjusting the projector speed you can adjust the rate of flashing to arrest the stroboscope pattern. As long as the pattern is stationary, the projector speed is in a definite relation to the capstan speed.

You will have to experiment a little to determine the correct number of bars for the capstan stroboscope. You can, however, make a good approximation by consulting the table below. First of all, you must find how many times the projector shutter cuts the light *right off* for every frame projected. The majority of projectors use a shutter obscuring the beam three times per frame. Some machines produce only two obscurations, others four.

STROBOSCOPES FOR TAPE RECORDER CAPSTANS

Shutter Obscurations per frame	*Projection Speed (f.p.s.)*	*Number of bars per inch Diameter of Capstan with tape moving at:* 3·75 *ins./sec.*	4·8 *ins./sec.*	7·2 *ins./sec.*	7·5 *ins./sec.*
2	16	26·8	21·0	—	13·4
	24	40·2	—	21·0	20·1
3	16	40·2	31·4	—	20·1
	24	60·3	—	31·4	30·2
4	16	53·5	41·9	—	26·8
	24	80·4	—	41·9	40·2



A mirror above the projection beam spills sufficient light on to the tape recorder to illuminate the capstan stroboscope. The disc can be mounted on a screw passing through a tube into a hole tapped in the end of the capstan shaft.

From the table find the number of black bars required on the stroboscope for every inch diameter of the capstan. Then if you multiply this number by the diameter of the capstan in inches, you get the number of bars needed for synchronisation at 16 f.p.s. or 24 f.p.s., as the case may be. Usually this includes an awkward fraction of a bar. As it is no use trying to draw a fraction of a bar on the stroboscopic disc, choose the nearest whole number of bars and run the projector slightly above or below 16 f.p.s. (or 24 f.p.s.) to arrest the stroboscope pattern. If you have more than eight bars on your disc, your projector speed will be within 1 f.p.s. of the speed you want. Projection at 15 f.p.s. instead of 16 f.p.s. does not greatly alter the tempo of a film.

For example, a projector runs at 16 f.p.s. and has a shutter providing three obscurations per frame. The tape speed is $7\frac{1}{2}$ inches per second and the capstan diameter

$\frac{3}{4}$ inch. From the table, the number of bars required on the stroboscope is theoretically $20{\cdot}1 \times \frac{3}{4} = 15{\cdot}1$.
In practice you would use 15 bars and the projector would run at $\frac{16 \times 15}{15{\cdot}1} = 15{\cdot}9$ f.p.s.

When you fit the stroboscope, take great care not to damage the working face of the capstan which comes in contact with the tape. If this does not run perfectly true, the recording will wow on reproduction. If the end of the capstan is accessible, stick the disc to it. You may have to extend the capstan shaft a little. As a temporary measure, you can do this with a matchstick held in place with modelling clay. The matchstick will be amply strong enough to support the disc at the top. A more permanent arrangement may require drilling and tapping the end of the shaft to take a screw thread. If you are not equipped to do this yourself, you can get it done at a local garage.

On some recorders, the capstan shaft seats on a steel ball at each end. You cannot then extend the shaft in this way. But you can still apply stroboscopic bars to the flywheel, provided you can arrange for it to be visible and illuminated by the projector. This may entail fitting a door or window in the side of the cabinet through which to observe the flywheel. In other cases it may be sufficient to remove the back of the cabinet for this purpose.

You can illuminate the stroboscope in one of three ways. In a small room you may get sufficient light reflected from the screen. More generally you will have to make special provision for lighting the stroboscope. You can project through a thin piece of glass or Perspex inclined so as to tip a fraction of the light on to the tape recorder. Alternatively use a small mirror just in front of the projector lens. This intercepts the extreme upper edge of the beam to deflect light to the stroboscope. Because the mirror is very close to the lens, it will not produce a sharp shadow on the screen.

As with any stroboscopic system, continuous observation and speed correction is a tedious business. Electro-mechanical systems are therefore available for controlling the projector speed automatically from the capstan speed. Usually they employ mechanical coupling from projector and recorder to a unit which switches a resistor in and out of the projector motor circuit. This controls the projector speed without affecting the speed of the capstan.

Synchronisation from Tape

Although synchronisation from the capstan can give good results, it cannot be perfect. There is always some degree of slip or creep between tape and capstan. This would be immaterial if it were constant. Unfortunately, anything which affects the tension on the tape will change the amount of slip. Moreover, the tape itself stretches and shrinks with changes in tension, temperature and humidity. If the tape carried perforations, like the ciné film, these factors could be eliminated by using a sprocket in place of a capstan. Some professional film studios do in fact use recorders of this type. For domestic purposes, however, unperforated tape is invariably used because it is cheaper, lighter and easier to handle than the perforated type.

Even with unperforated tape, however, you can get perfectly accurate synchronisation provided the tape carries regular marks which can be related to the frames on your film. One make of a paper-based tape carries printed stroboscopic marks on the back. It is intended for use at $7\frac{1}{2}$ inches per second and so 16 black bars are printed in every $7\frac{1}{2}$ inches. Thus one bar moves by for every frame of a film running at 16 f.p.s. In use, you illuminate the tape from the projector beam in the same manner as a capstan stroboscope (p. 94). The pulsating light transmitted by the projector shutter should then appear to arrest the motion of the marks on the tape. Usually a silent projector has a shutter operating three times for every frame projected. This makes

the bars appear only one-third of their true width, but spaced three times as closely. Sound film projectors generally have shutters operating twice per frame. They will therefore produce a similar effect when running at 24 f.p.s.

This stroboscopic system produces more reliable results than the others described above. But like them, it calls for a careful and constant watch on the bars and frequent correction of the projector speed. For professional purposes, several schemes are in use to eliminate this tedious job. In one, a photo-cell "watches" the printed bars and is made to adjust the motor speed accordingly. In another arrangement, no visible marks appear on the tape. Instead, tone pulses are recorded magnetically alongside the sound record. Generally, one pulse is recorded for every frame on the film. For playback or re-recording, an additional playback head is used to detect the pulses and these are kept in step with the film.

At present, the cost and elaboration of equipment for operating such systems place them beyond reach of the amateur. On the other hand, they hold three great attractions. They combine the low running costs of magnetic tape, the accuracy of synchronisation found in sound-on-film, and the advantages of a sound track which can be edited independently of the film. If ever it becomes available, a simple and cheap version of the professional equipment will be a highly attractive proposition.

Stripe Recording

The great advantage of magnetic stripe is that timing problems are eliminated. You have only to speak the commentary in step with the picture and it can never be reproduced out of synchronism. The recording is carried on the film itself and speed variations affect the picture and sound to the same extent.

Projector Noise

Although this single-system recording overcomes several serious problems, it introduces new ones. The most troublesome is projector noise.

Magnetic stripe projectors are designed to run as quietly as possible and are often built into a blimp or box which deadens the sound. Nevertheless the reciprocating parts in a projector inevitably make more noise than a smoothly rotating tape recorder and since the stripe projector must be running during recording, it is difficult to produce a commentary which has no background of projector noise. This can be minimised in various ways.

1. Speaking louder and turning down the volume.
2. Speaking closer to the microphone and turning down the volume.
3. Using a directional microphone.
4. Increasing the distance from projector to microphone.
5. Muffling the projector noise.
6. Placing the projector and commentator in separate rooms.

None of these remedies is as simple as it appears and you may have to use a combination of them all. Let us consider them separately.

1. It is evident that you can reduce the playback level of the projector noise by turning down the volume while you are recording. Equally, you can preserve the playback level of your commentary by raising your voice during recording. Provided the recording level indicator is just flashing in both cases, you will record your voice at the same level, but reduce the projector noise.

Unfortunately you cannot extend this principle very far. Quite independently of volume level, it is easy to tell whether a commentary has been shouted or merely spoken. In most cases a shouted commentary is inappropriate. So use a loud clear voice, but do not shout.

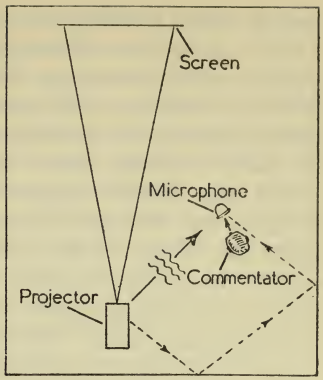
2. By speaking closer to the microphone, you can again record your voice louder relative to the projector noise. In doing this, however, you will record a preponderance of the low frequencies in your voice. Consequently the recording sounds "boomy" on playback, particularly at high volumes. You can correct this to some extent by manipulation of the tone control—preferably during recording.

When you speak close to the microphone, the distance at which you speak becomes very critical. Speaking at 18 inches from the microphone, you can move 6 inches either way with little effect on the sound. Speaking at 3 inches, however, you must move no more than 1 inch. You will find it difficult to keep your head sufficiently still in such circumstances, particularly when you want to look from script to screen at intervals.

A partial solution lies in holding the microphone in your hand. You can easily learn to keep it at a constant distance from your lips. However, this practice usually introduces all sorts of handling noises—rustles and thumps at every movement.

The best compromise is to mount the microphone on a separate table or chair back and speak from a distance of about 6 to 9 inches. Take care not to touch the microphone support as this will spoil the recording with thumps.

3. Some microphones are directional, i.e., they are



If the microphone is insensitive to sounds coming from the side, this characteristic can be used to reduce the pick-up of projector noise. In a small room, however, the improvement is largely invalidated by noise reflected from walls and the ceiling.

sensitive only to sounds coming from certain directions. You can use this property to minimise projector noise. Choose the recording set-up so that the insensitive axis of the microphone is directed towards the projector while the sensitive axis faces the commentator.

Although this will make a big improvement, it is seldom a complete cure. This is because the walls of an average room reflect sound to a large extent so that it arrives at the microphone from many directions. In this respect, a large room gives less trouble than a small one and a furnished room is better than an empty one.

4. Whatever microphone you use, do not stand it close alongside the projector. Get somebody to work the projector while you use the microphone at the full distance permitted by its lead. An obvious elaboration is to lengthen the lead so that you can take the microphone further from the projector. However, technical difficulties arise here. A long lead will often result in hum or a loss in quality. If it is essential to extend the microphone lead, seek the assistance of a good radio serviceman.

5. Generally speaking, it is simple to reduce the noise at the projector itself. You can often effect a substantial reduction by standing the projector on something soft. A

sponge rubber kneeling mat is ideal. The mat may produce a little unsteadiness of the picture, but this is of no consequence during recording though it would be disastrous before an audience. The important thing is that the sponge rubber prevents the vibration of the projector from reaching the table top which can act as a sounding board.

You can further improve matters by constructing a primitive tent around the projector. A convenient way is to stand two chairs on the table back to back, before and behind the projector. Then drape a blanket over the two chairs to envelop the projector but for a free space between the legs of one chair. This is for the projector beam. You can lift the blanket at one side to thread the projector and also to ventilate it at frequent intervals between recordings.

6. The ideal arrangement is to have projector and commentator separated by a sound-proof wall. There must be a window in the wall through which to project or through which the commentator may watch the picture.

A serving hatch will often serve this purpose. You can mount a piece of glass in a frame made as a push fit into the hatch. The frame must be notched to accommodate the microphone lead which goes through the opening.

Alternatively, you can project through a doorway. It is best then to place the microphone behind the open door, and cover most of the opening with a curtain or blanket.

Film Speed

When you shoot a silent film, you need think only of the picture. When you shoot a film which is to be striped, however, you must remember that sound is to be added.

In 8 mm. for example, the sound quality obtained at 16 f.p.s. is barely sufficient for clear reproduction of speech. Music sounds decidedly poor. This is because the linear speed of the film is only 2·4 inches per second. Tape recorders designed to give good quality reproduction of music run at 7·5 inches per second. Running at one-third

of this speed, the 8-mm. film can reproduce only a correspondingly limited range of frequencies.

Better sound quality results if you record and reproduce 8-mm. film at 24 f.p.s. The linear speed is then 3·6 inches per second which gives reasonable quality of speech and makes possible the recording of certain kinds of music.

So if you are going to use stripe in 8 mm., you should shoot and project your films at 24 f.p.s. Do not forget to open your camera lens aperture by half a stop to off-set the reduction in exposure time at the higher speed.

On 9·5 mm. and 16 mm. you can get good sound quality even at 16 f.p.s. The linear speed—4·8 inches per second—is sufficient for good quality speech and quite good music. But here again, better results are produced at 24 f.p.s. The linear speed then rises to 7·2 inches per second and the quality is almost identical with that of a tape recorder running at 7·5 inches per second. At this speed your sound track will do full justice to any speech or music you are likely to record.

Of course the increased film speed adds to your film costs since you need 50 per cent. more film for a given time.

Whenever possible shoot a film at the speed at which you project it. If you want to project at 24 f.p.s., run the camera at this speed. Some cameras run at only one speed, however. You must then choose between two alternatives:

1. Shooting at 16 f.p.s. for $1\frac{1}{2}$ times the normal time.
2. Having the camera speed re-set at 24 f.p.s.

There are objections to both these methods.

If there is any action on the screen, it will be speeded up when projected at 24 f.p.s. You have seen this effect when historic newsreels have been shown at the professional cinema. You can minimise the effect by avoiding violent action and asking people to walk slowly.

Every camera has a governor to control the speed. In a single-speed model, this may not be accessible from the outside. But a camera repair agent could re-set the governor to increase the speed, possibly as far as 24 f.p.s.

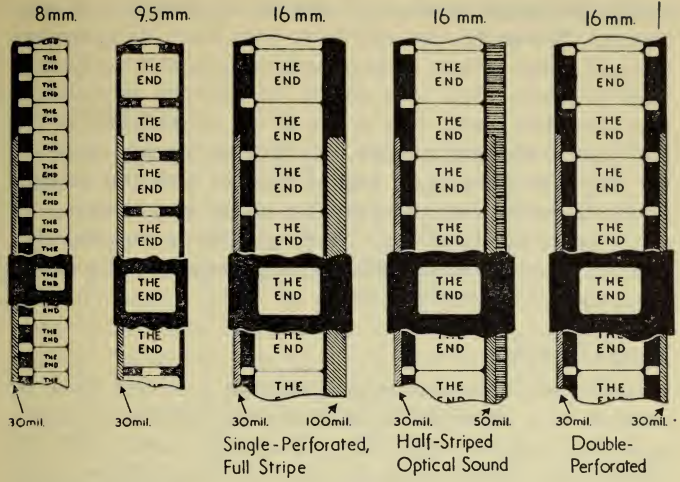
If the camera is not designed for this speed, you may encounter a variety of troubles. The most likely are slow starting and poor speed stability. These will show up as density variations in the final picture. So after adjustment, check your camera by exposing some cheap film stock on a subject containing a full range of greys. You will then see how quickly the camera attains full speed and for how long it maintains it.

Film Stock

Magnetic stripe is applied to the side of the film facing the projector lamp. This means that if you use reversal film in the camera, the stripe will eventually be applied to the base (shiny) side of the film. The magnetic coating adheres very well to film base and, provided the film is clean in the first place, will not tend to flake off.

If you shoot your film on negative stock, however, a normal contact print has the emulsion side facing the projector lamp. If the magnetic coating is applied to the emulsion, the adhesion is not as good as to the base. After a while it may flake off in parts. You can avoid this danger by having your films optically printed so that they are projected with the emulsion towards the lens.

The first standards adopted for 16-mm. magnetic sound films prescribed the simple substitution of a magnetic stripe for the familiar optical sound track. This requires single-perforated film for projection as the sound track lies where the second row of perforations come on a silent film. If you use reversal film, you must therefore shoot on single-perforated stock. The single-perforated film is available from several manufacturers and costs no more than the double-perforated type. With a few cameras its use presents no problem. With others, you may have to get the teeth removed from one side of the camera sprockets. If the camera claw is on the left of the film, looking at it from the back, even this will not do, however. Magazine-loading



The three popular film gauges, showing the picture areas exposed in the camera, the position and width of the magnetic stripe and the picture area visible through the projector gate. Even in 9·5 mm., the magnetic stripe does not detract from the projected picture width even though it encroaches on the exposed picture. A 30-mil balancing stripe is commonly added on the left of 16-mm. film to promote good spooling.

cameras have the claw on the left and this is why you cannot buy single-perforated stock in magazines.

If you want to make magnetic sound films with a magazine-loading camera, you can, of course, have reversal duplicates made on to single-perforated stock. However, it is cheaper and simpler to work to an alternative standard devised specifically for amateurs. This prescribes the use of double-perforated film with the sound track applied at one side of the film, between the perforations and the edge. Since there is little space available in this position, the sound track is made only 30 mils (0·03 inch) wide, instead of 100 mils (0·1 inch) as on the single-perforated films.

The wider sound track has the advantage of giving better sound reproduction. But if you use the narrower stripe on

double-perforated stock, you can use reversal film in any camera. Moreover, you can have your silent films striped and add sound to them without making expensive duplicates. Unfortunately, there is a danger of sprocket modulation with shrunken films. This is due to the variable curl in the film next to the perforations. As each perforation goes by, the stripe moves in and out of contact with the record/playback head. Consequently the sound is modulated by an unpleasant throbbing. This trouble is considerably reduced when a spring-loaded roller presses the film firmly on to the record/playback head.

Half-Track

Half-track is another way of striping a 16-mm. film. It consists of a 50-mil (0·05 inch) stripe applied to a single-perforated optical sound film. The stripe covers half the width of the optical track, leaving the other half free to be scanned in the usual way. Thus you can always choose between playing the optical track or sound recorded on the magnetic stripe.

For professional purposes this is frequently useful. For the amateur, the system has limited appeal. However, it does mean that without renouncing your ability to use the original track on a film you have bought, you can provide sound better suited to your personal requirements.

Sound recorded magnetically in this way is good. It is, in fact, better than sound from a striped double-perforated film. On the other hand sound from the optical track suffers to some extent, even if the type of optical recording lends itself to the process. Variable density recordings can be half-striped successfully. Variable area recordings can be half-striped provided they are symmetrical about the centre of the track. They will, however, suffer an increase in noise and distortion. Unsymmetrical or unilateral variable area recordings are not suitable for half-striping at all.

Before having a film half-striped, make sure the type of optical track is the same throughout. Title music, for

example, might be recorded on one system and dialogue on another.

Spooling

The magnetic stripe is very thin—about one-tenth of the film thickness. When the film is spooled, however, the presence of a stripe on only one edge encourages buckling and irregular spooling. It is general practice, therefore, to apply a balancing stripe along the opposite edge of the film. The film then spools in a normal manner. Because its overall thickness is increased by one-tenth, however, you can get rather less film on a reel after striping. A 400-foot reel will hold only 360 feet, and so on. So don't fill a reel too exactly before despatching for striping.

Cleanliness

No careful projectionist allows oil, grease or dirt to get on his films. But he may have wax applied to protect both film and projector against corning up. The very thin layer of wax over the margins of the film guards against the loss of particles of emulsion in the gate channels. It is these particles of emulsion which sometimes scratch the film and build up, snowball fashion, into a surprisingly hard corn.

A magnetic coating cannot be applied to the film while there is wax, oil or grease on the surface. So if your film is not perfectly clean, have it cleaned before striping. If you hope to avoid this necessity, wear thin cotton gloves to handle the film during editing. Bare fingers inevitably leave greasy marks and these are doubly objectionable on film for striping.

When you use a magnetic stripe projector, be particularly careful to keep everything clean. The magnetic oxide used for the stripe is highly abrasive. So if any rubs off the film during projection, see it does not get into the projector mechanism.

Sound Editing

A difficulty with magnetic stripe is that of fitting sound accurately to a sequence including rapid cutting. You may then have to record a different sound every second. It is out of the question to record all the sound at one attempt. Instead, you must run the film through the projector several times, recording different passages each time. There are two ways in which you can tackle this.

1. By recording one or more passages, reversing, checking, and then recording other passages.

2. By making an endless loop which can run repeatedly through the projector until you have recorded all the sound correctly.

Both these methods produce excellent results when used properly. However, there are several points to watch if you want to work quickly.

If you intend recording, going back, checking and then recording a further passage, you need a projector which can run in reverse. Some, but not all, magnetic stripe projectors have this facility. Those that do not, must be unthreaded and re-threaded every time you want to go back, and this is a tedious business.

When you record sound for one shot, you may have to be careful not only where you start it, but also where you stop. On some projectors the erase head is a considerable distance ahead of the record/playback head. This means that when you switch from "playback" to "record-erase", over a foot of film between the two heads will not be erased although you would like it to be. So if you let the sound for one shot overrun a little, it will not be erased automatically when you record for the next shot.

On the other hand, some projectors are constructed so that the erase head is very close to the recording head. Then it is actually desirable to let each recording overrun. When you add the next passage of sound, you erase the end of the preceding passage and the two fit without gap or overlap.

If the projector has no facility for reverse running, you will find it quicker to make rapidly cut sections up into loops. You can then project the same few shots repeatedly, adding sound to a fresh shot at each passage. Splice a length of unstriped film (preferably black) between the beginning and end of the loop. One loop should be as long as you can handle without risk of damage. Generally 20–30 feet is the limit.

The black unstriped film should be at least 26 frames long. This will ensure that you are not misled by recording sound for the first shot on the stripe alongside the last shot.

Adding sound to a loop of this sort is quite simple after a little practice. First of all, it is a good plan to erase completely any existing recording on the stripe. This is essential if your projector has an erase head greatly preceding the record/playback head. Now wait for the black leader. As soon as it has passed through the gate, record sound for the first shot. Immediately at the end of the shot, switch to "playback". You can check this first recording on its next passage through the projector. If it seems satisfactory, switch to "record" at the end of the first shot and record sound for the second shot.

Working in this way, it is a fairly simple matter to add sound to the most difficult sequence. You will not, of course, be able to record sound to the first 26 frames of each loop because the corresponding track would be on the unstriped leader. However, it does not take long to record the appropriate sound once the loops have been spliced together again in the correct order.

Whichever method you use, loop or shuttling to and fro, you may encounter a minor timing difficulty. During recording, you may tend to be slow off the mark switching in the sound for each shot. If the delay is noticeable on playback, you can usually eliminate it from future recordings by threading the projector with a bottom loop greater than normal. This means that during the recording sessions, the projected picture will, as it were, anticipate the picture the

audience will see. If you increase the bottom loop by eight frames, you can intentionally delay starting and stopping your recording by one-third of a second (at 24 f.p.s.) or half a second (at 16 f.p.s.). Of course, on playback you will not obtain the correct synchronism until you return the bottom loop to its normal size.

Splicing

In general, you should edit your films before sending them off for striping, i.e., the application of the magnetic stripe. The stripe will then continue over the splice and there will be little or no disturbance in the sound recorded later.

If the film breaks, or if you use the loop system of recording just described, you will have to splice the film after striping. Here it is advisable to remove the stripe, as well as the emulsion, from the surfaces to be cemented. There will remain a substantially continuous stripe, nevertheless, and you can record on this satisfactorily. However, be careful not to let film cement spread on to the stripe or it will tend to flake off.

Removing Clicks

Should an old splice break, you will want to remake the splice without making a new recording. You may then be puzzled to hear a click as the splice passes the playback head. This will probably be due to local magnetisation of the track by magnetic parts of the splicer. Either use a splicer free of steel and iron, or else you must have the offending parts demagnetised periodically. Your watch repairer can probably do this for a nominal charge.

Another kind of click is that produced when you switch from "playback" to "record", or vice versa. Whether clicks arise from this source or from the splicer, they are equally offensive to the critical ear.

With the projector at "playback" inch the film through until you locate the click. Mark the margin of the film with a wax pencil directly opposite the record/playback head. Then inch the film back until the grease mark is immediately opposite the erase head. By adjusting controls, or by skewing or unthreading the film, remove the track from registration with the recording head gap, but keep it opposite the erase head. Switch to "record-erase" and inch the film back and forth through about $\frac{1}{8}$ inch. This will erase the click with negligible effect on adjacent sound.

If you have a lot of clicks to erase, it is obviously easiest to mark them all first and erase them all in turn.

Mood Music

Mood music improves almost any film. And when you come to experiment, you will find that a surprising diversity of musical works go quite well with any particular film.

On the other hand some kinds of music are of very little use for films. Vocal pieces, for example, are distracting because the audience attends more to the voice than to the picture. Very occasionally you will find a use for vocal music—if somebody is supposed to be listening to a radio, for instance. But in such a case the song is more in the nature of a sound effect than mood music.

To a lesser extent, much the same applies to brass bands, cinema organs and other sources of music which are likely to have strong associations for the audience. Brass band music can accompany pictures of a parade, circus or similar function. But it is scarcely suitable for a film consisting mainly of scenes in the country or on the beach.

Piano music is seldom satisfactory either; its percussive nature commands too much attention. Stringed instruments, such as the violin, viola and cello provide a smoother, less obtrusive accompaniment. So in general you are safe in using music primarily by strings, whether a quartet or a symphony orchestra.

Avoid popular and well-known tunes which an audience may hum or whistle.

Catchy tunes are dangerous also, although you can use one as a theme tune to great effect.

At all times remember that the music is secondary to the picture. It should help, but not carry, the film. So for the most part, choose restrained passages and keep your big guns for the climax.

Climax and Interlude

Every good film has a climax. If the film is bad, you must try to contrive one. If you have ever endured an omnibus edition of a serial thriller, you will know that it rushes from one situation to another with no breathing space between.

A well-contrived plot emphasises the tenser moments by the introduction of quieter interludes.

Without these interludes, the story is a monotonous succession of crises. By the end you are either worn out or bored stiff.

In selecting music for a film, analyse the plot very broadly. Decide which points constitute the crises and which to treat as interludes. In a story film, see if there are two main themes: hero and heroine, or hero and villain.

Many successful plots are constructed on the same plan as a sonata movement in music. There is a first theme (hero) and a second theme (villain). These are established separately and then you have an interplay or development of the two themes. This reaches the main climax, followed by a repetition of the original themes. In music this repetition is called the recapitulation. In the film it may threaten to be a decapitation. The hero, about to be lynched, reaffirms that he stands for all that is fine. The villain, apparently triumphant, declares that he will stoop to anything. Then there is a quick scuffle, a minor climax, and everything ends as it should.

Learn to interpret a plot on these broad lines. Not only will you derive greater enjoyment from repeated screenings of a film, but you will be able to select music to convey that enjoyment to others. This is impossible if you do not understand "where the film is going".

Coherence

Not every film is a story film, of course. The majority of amateur films are concerned with summer holidays, or baby

on the lawn. Nevertheless, every film should have some sense of direction. If it has not, try to instil one.

The story of a summer holiday may have degenerated to a mere collection of shots. But you can heighten the contrasts with the right sort of music and unify the whole by using the same accompaniment for the interludes. An effective method is to choose all the music from the same suite or symphony.

Provided you can choose a work suited to the film, this is a great help in other ways too. The same themes are used repeatedly so that you can jump from one part of a movement to another without an unpleasant jolt. Sometimes, indeed, you can switch from one movement to another without trouble. Because the movements are written in related keys, the transition is not disturbing and you do, in fact, get a smooth flow.

With separate works this is not the case. Quite often you may select pieces which appear ideally suited to a pair of consecutive sequences. Yet when you try to fade from one piece to the other, the change of key is almost painful. The remedy is to change one piece. Alternatively, interpose a bridge, i.e., a piece in a key which forms a stepping stone between the other two.

Only One Rule

Does this sound complicated? You have been told not to use brass bands, piano or vocal music. Dramatic construction and key relationships have all come into the discussion.

Is the whole business too difficult after all?

Not in the least! You need remember only one important rule. The audience should not be conscious of the music nor complain of a lack of natural sound. You will provide good music so long as you conform to this rule. But the points above are raised to provide you with a short cut to your goal. You would discover them for yourself after a time, but it might be a long time.

Music Libraries

When choosing music for a given film, it is useful to have access to a library of recorded music. A good collection of gramophone records is a convenient basis.

The more comprehensive the collection, the more important it is to have it catalogued adequately. This does not mean merely listing the records under their titles or composers even though you can often find inspiration by looking down such a list. A catalogue is more useful if it classifies the records according to mood. So tabulate your records under the following headings:

Sad, tragic	Gay, bright
Eerie, weird	Festive
Sinister, foreboding	Peaceful, pastoral
Disaster, pain	Triumphal
Storm, fire	Serene, dreamy
Spiritual, religious	Martial, circus
Hurry, pursuit	Grand, majestic
Fanfare	Dainty, pretty
Slapstick	Children

Each record usually embraces several moods and a considerable amount of cross-indexing is therefore necessary. For example, Dukas' "Sorcerer's Apprentice" begins and ends in a mood which should be classified as "eerie, weird". The greater part of the piece, however, could be described as "slapstick", as "hurry, pursuit" or as "storm, fire".

So do not be misled by titles. The name on the record does not make the music sound any different. Just shut your eyes, use your imagination, listen to the record and list it accordingly.

Final Choice

You are justified in using any music with any film provided it fits its context. You should therefore collect records covering a wide range of moods and without consideration of the titles. Try to avoid the more popular works, even in classical music. Symphonies such as Dvořák's "New World",

or César Franck's D Minor are too appealing to be generally satisfactory. The audience may try to show its approval of these more tuneful works by beating time or whistling snatches. When this happens, the music is drawing attention to itself and away from the picture.

Seek out lesser known works—Sibelius' 4th and 6th Symphonies and even more modern works. Provided they are not so strident as to command excessive attention, pieces with a less obvious tune usually blend well with the picture. So get records of these pieces. The less they appeal at first hearing, the more useful they may prove later. And incidentally, they often become firm favourites after several hearings.

Works of this type generally have the merit of being usefully ambiguous. One piece can paint several moods—eeriness or calm, serenity or foreboding. This means that the music often matches the picture better than a piece in a more clearly defined mood. Consequently you need change the music less often and so there are fewer breaks to distract your audience. Also, because the key and tempo of such a work are usually less sharply defined, a fade from one piece to another is less disturbing.

Silence

Very occasionally, silence can be more effective than any music. When you have carefully prepared the audience for a tense situation, turn off the sound. Provided their eyes are watching the fraying rope, the helplessly swinging mountaineer, the ears of the audience will subconsciously strain for the impending snap and scream. The effect is similar to the substitution of drum roll for music when an acrobat comes to his *pièce de résistance*. Here, however, the projector noise plays the part of the drum roll. See that it is not so loud as to spoil the effect.

In many cases, the effectiveness of silence in a sequence of this kind is heightened if it is explained. If you are planning

a mountaineering sequence such as that above, present it as being seen through binoculars from some way off. In this way you can portray the climber's terror in close-up whilst keeping the audience remote, helpless and in silence.

Counterpoint

An alternative treatment involves the use of music in counterpoint to the picture. In this case the picture shows one aspect or mood, while the sound presents a contrasting aspect. Usually this makes sense only if you have followed the preceding story. It is, therefore, a device to use only when the film is really well made. In other cases it will lead to confusion.

When the mountaineer slips, for example, the music can change from foreboding to gay. This might symbolise the girl who has dared him to undertake a foolhardy expedition. As he hangs from the fraying rope, the dance music (established already in connection with the girl) tells us he is thinking of her. But see that it *does* tell people this. Don't make them think you have put on the wrong record.

Commentaries

Once you can record your own sound you will want to record commentaries for your films. A commentary can convey so much more than sub-titles alone and it does not impede the flow of pictures.

Nevertheless, the writing and recording of a commentary present their own peculiar difficulties (p.51). If you want to convey information in the sound track you must provide appropriate picture footage to go with it. The commentary must come to the point quickly so that the audience can study the subject—a church bell, say—you are discussing. And the picture must remain for a few seconds after your comments in order to satisfy the interest aroused.

Importance of Sequences

It takes several seconds to say anything interesting, so your church bell must be on the screen for a minimum of 10 seconds, possibly 20. A single shot of this duration is monotonous and unnecessary. For a sound film it is, therefore, essential to shoot in sequences, i.e., related shots on the same subject. In this case, you would start, as in a silent film, with a long shot showing the church. Next comes a medium shot of the bell-cot. Then, perhaps, several close-ups of the bell and its mounting and finally shots of the bell being rung. In a script these types of shot are usually abbreviated to LS, MS, CU, etc.

Word your commentary so that it flows smoothly, yet follows the pictures. This sounds obvious, yet it is all too easy to end up with this sort of thing:

"During the Reformation, most of the Sanctus bells in England were destroyed.

This one at Elmshurst survived and is still rung every Sunday. The inscription invokes the protection of St. Augustine and dates from the casting of the bell in 1523."

When you try this with the film, you find that the bell is stationary while you are talking about its being rung. Later it is chiming while you discuss the inscription. You might, of course, rearrange the shots to get over this. But then you find it unsatisfactory to see the bell at rest after it has been chiming.

It is much better to revise the commentary to get over this difficulty. At the same time, you can improve it in several other respects. For example, it is illogical to leave the casting of the bell till the end. After a while you can arrive at this:

	Shot	*Commentary*
LS	Church, from higher up valley.	Just above Elmshurst stands the church of St. Augustine.
MLS	Church. Two people enter churchyard.	
MS	Bell-cot over roof.	The bell-cot over the chancel gable holds one of the few Sanctus bells in England to survive the Reformation. Ever since it was cast in 1523, it has called on St. Augustine, "Protect thy bell and keep it sound". He has protected it well and it chimes on Sundays as it has done for four hundred years.
CS	Bell	
CS	Part of inscription	
MCS	Two people looking up	
CS	Bell chiming	(*Fade-in sound of bell chiming.*)

This provides a far better combination. The commentary reads smoothly and logically, yet fits the film all along.

Choice of Words

Before attempting to record your commentary, try reading it aloud, and if possible recording it completely by itself on a tape recorder, and you will probably discover several minor defects. For example, in the passage above,

the word "it" occurs six times in the last two sentences. The first two "its" are ambiguous because the preceding noun is "Reformation", not "bell". But if you change one to "bell", you get,

"Ever since the *bell* was cast in 1523, it has called on St. Augustine, 'Protect thy *bell* and keep it sound'. He has protected it *well* . . ."

The succession, *bell*, *bell*, *well*, provides an echo effect which is irritating when spoken aloud. The same applies to a lesser extent to "protect" and "protected".

A way out is the use of synonyms. Normally there is no other word meaning exactly the same as bell. But here you are lucky—"Sanctus" will meet the case. The substitution of "guarded" for "protected" is also useful. Not only does it eliminate repetition, but it relieves some of the stress on the word "well".

Try it for yourself. Read the first version aloud, and then try this:

". . . The bell-cot over the chancel holds one of the few Sanctus bells in England to survive the Reformation. Ever since it was cast in 1523, the Sanctus has called on St. Augustine: 'Protect thy bell and keep it sound'. He has guarded it well and it chimes on Sundays as it has done for four hundred years."

The difference is not great, but in a long film, a carefully polished commentary repays the work involved. Yes, it does involve work. The example above takes less than 25 seconds to read, yet it took as many minutes to work out.

Timing

This does not necessarily mean that it should take 10 hours to write the commentary for a 10-minute film. Much depends on the proportion of the film requiring a commentary at all. Commentator and audience will find an occasional rest equally welcome. So if you have no information to impart, keep quiet.

By introducing frequent breaks in the commentary, you can also greatly simplify timing. Start each section at its

own cue mark, and you can often speak for half a minute without having to look at the screen.

There are exceptions, of course. If you word your commentary to read:

"This Latin inscription calls on St. Augustine. . ."

then you must time this to the appropriate shot. When there are several sentences immediately preceding the critical one, careful rehearsal is required.

With the magnetic stripe system, timing must be perfect during recording. This costs no more than a little patience, since unsuccessful attempts can be erased and replaced without further expense. With direct disc recordings each fault means a disc wasted and a considerable addition to your costs. Using magnetic tape or optical sound negatives the timing can be readjusted by cutting tape or film in or out as necessary.

Using either disc or tape, you must word the commentary so that it demands no greater accuracy of timing than you can obtain during playback. In the church bell sequence, six shots accompany 24 seconds of commentary, an average of four seconds per shot. Your synchronisation may provide an accuracy of plus or minus two seconds on playback. This is quite good for a long film, yet it allows insufficient time for reference to any specific four-second shot. Therefore, you cannot refer particularly to the shot showing the inscription. Either you must extend your important shot, duplicate it with similar shots, or comment less critically.

Tense

You will have the greatest difficulty with comic sequences. Here the comments usually require accurate timing.

Suppose you show a slapstick incident in which Father repeatedly trips over the doormat. The commentary might be in the past, present or future tense. But if you use the future the edge is taken off the humour. ". . . He will do it

again—" tells the audience in advance what they are going to see. It is equally unsatisfactory to say ". . . he did it again" *after* everyone has seen it happen. Greater impact comes from a commentary in the present tense— ". . . here he goes again". But obviously this must be spoken in step with the picture and the permissible timing error is less than one second.

For more serious subjects also the present tense is more attractive. For describing processes, it is ideal—

"He selects only straight-grained pieces for the ribs. Knots and bruises weaken the frame."

Notice too, that this is in the active voice. Using the passive voice—

"Only straight-grained pieces are used for the ribs, the frame is weakened by knots and bruises."

—the commentary is less personal, less interesting and appreciably longer.

Films of an historical nature inevitably call for the past tense. If the film is the record of a particular cruise in a particular year, you will say, "As we came into the harbour . . ." But if it is a travelogue, a picture of a typical cruise, you still use the present tense—"As we come into the harbour . . ."

Fluency

Although your commentary should not be continuous, it must not move along in jerks either. Each sentence should follow naturally from its predecessor. After a period of silence, a new passage must arise naturally from the picture.

Suppose for example, the film depicts a village since destroyed by an avalanche. It is somewhat abrupt to present the audience with:

"We spent the weekend at Einmal. The whole village was destroyed by an avalanche two years later."

The two sentences are unconnected. Also the audience

half expects to see shots of the devastation. You can meet both these objections by a rather different treatment:

"We spent the weekend at Einmal. We little thought that only two years later this beautiful snow would carry away the whole village."

The who-would-have-thought-it treatment is a useful excuse for referring to something which is not, or cannot be, shown in the film. It keeps attention firmly on the screen while referring to other events. But don't use it more than once in the same film or the audience will recognise the dodge.

Titles and Music

Professional newsreels employ sub-titles as well as commentary, although sub-titles rarely appear in documentary or fiction films. In both these categories, music is commonly used as well as speech. There are, however, a number of pitfalls if you employ titles or music indiscriminately in a film provided with spoken commentary.

Titles consist of words. So does the commentary. Just as you cannot listen to two people at once, so you cannot read and listen simultaneously. If you use sub-titles in a film, no commentary must be provided while they are on the screen. If the commentary is on tape, leave a margin of silence for several seconds before and after each sub-title to allow for errors in synchronisation.

Professional films use sub-titles almost exclusively to establish the place or occasion. If you do the same, your film can be suitable for occasional screening without sound, yet perfectly balanced with it. In a film of your holiday abroad, each new town or village can be introduced by a simple title, a close-up of a sign or a name on the map. When your commentary casually introduces the name later, the audience will recognise your pronunciation, right or wrong. (So *that's* how you pronounce Meopham?)

With music, much the same applies. Use it to help the film, but not to compete with the commentary. Use music when there is no commentary. The rest of the time, make

the music as inconspicuous as possible. This does not necessarily mean that the music should stop completely for the commentary, in fact, this is seldom desirable. Such a procedure heralds each passage of speech by an abrupt fading out of the music. The resumption of the music later on is equally abrupt.

It is far better to fade the music to a fairly low level and bring it up again at the end. But choose music with a slow tempo unlikely to prove distracting. The commentary provides a useful cover for the transition from one piece of music to another. Fade down the music just before the voice begins, then fade right out. Start the new piece very quietly and gradually bring it up to quarter volume. When the commentary ends, bring the music smoothly up.

Voices

Listen attentively to your commentator's voice and see whether it blends with the music which will precede and follow. Occasionally it happens that a voice is of such a well-defined pitch that it establishes the appropriate musical key in the minds of the audience. Any music following will sound off-pitch if it is not in a related key (see p. 112).

You will be lucky if this is the only fault you can find in your commentator. Some people get stage-fright before a microphone. Others become hopelessly artificial. Some never speak distinctly and yet others do not record well.

If your own voice is not really suited to the microphone, face up to it! Find a friend who can speak with interest and expression. He will be flattered by your request for help, you will be better pleased with your film and your audiences will be impressed by the result.

Sound Effects

The sequence about a church bell (p. 116) ended with shots of the bell chiming. In such a case, whether or not you use a commentary, the audience expects to hear the bell as well as see it. You should therefore provide the appropriate sound effect.

Effects Records

If you are using gramophone turntables to provide mood music, you can introduce occasional sound effects with stage effects records made by some of the leading gramophone companies. Usually each record carries a variety of effects. The range of sounds covered is wide, ranging from a baby crying to feet walking on duckboards. Some sounds are available in a number of forms: you can choose a recording of a crowd in anger or in fear, laughing or cheering.

Comprehensive though the range may appear you will often require effects which are not listed or which are not to hand. For example, when you want to add the bell effect you may find that you have access only to a record of Big Ben. This is so familiar to any British audience that you can scarcely pass it off as a much smaller Sanctus bell. By running the turntable faster, however, you can raise the pitch of the recording enough to change the character of the chime completely. In this way you can make the pitch of recorded chimes correspond with that of the bell you filmed.

For this purpose, you require a turntable with variable speeds. The governor-controlled type (p. 24). is the most useful, although the popular two- and three-speed types can be valuable also.

A number of unusual effects can be produced by playing

records below the usual speed. A slowed-down version of machine-gun fire has been used in a dockyard sequence to simulate the rattle of chains. When the appropriate effect is not to hand, an extremely slow reproduction of Chopin's Funeral March provides a good imitation of the drone of aircraft.

Recording Your Own Effects

Effects records are still useful even if you do your own magnetic recording. You will not take a recorder with you wherever you use the camera. So you will still draw on discs for the sounds of cars and crowds, planes and trains, transferring them to tape or stripe as necessary.

Of course, there are many sounds you can record without difficulty—a clock striking, barking dogs, or a tap running. However even quite simple effects can pose problems. Suppose you have filmed the children playing in the garden with the dog. You want a record of his bark, but indoors the acoustics are very different. The recording does not sound right unless it is made out of doors. The solution lies in having your recorder indoors, the microphone on the window sill and the dog outdoors.

Some effects simply don't record as you expect them to. You must then counter the tricks of the microphone by devising tricks of your own. Often you have to provide a caricature of the sound you require.

At other times the effect must be synthesised because the real thing is unobtainable. The classic example is the crushing of a matchbox close to the microphone to provide the sound of a crashing aeroplane. Fortunately the amateur rarely films such a subject. A difficulty you will meet more often is that of simulating the roar of a waterfall. You can produce this effect by turning a ball of steel wool on glass-paper while breathing through your mouth near the microphone as you would to clean a pair of spectacles. By adjusting the relative distances of your mouth and the

glasspaper from the microphone, you get a balance. In this, as in a multitude of home-made effects, it is difficult to reproduce the complexity of the original sound. In the waterfall effect, for example, there will be discontinuities as you draw breath. Although the real sound contains irregularities also, it includes a continuous background noise represented only in part by the steel wool or glasspaper. You can, however, get over this by superimposing two or more recordings (p. 80). The final sound then represents the breathing of several people who draw breath at different times. You can use a similar technique to build up crowd and traffic noises.

Sound as a Link

In a well-constructed film, sound is not just something "stuck-on". It forms an essential part of the whole and can carry information which would otherwise require several additional shots.

Consider a simple sequence showing Jack scrambling in the back of a lorry which subsequently heads for Leicester. A silent film might show this as follows:

1	*MS*	Jack scrambles in the back of lorry.
2	*MS*	The driver slams his door and settles to the wheel.
3	*CS*	Lorry wheel begins turning.
4	*LS*	Lorry appears round bend. Camera follows until in close-up and then stops on signpost, "Leicester".

In a sound film, you *could* use exactly the same script, merely adding the appropriate sounds in synchronisation with the pictures. But you get a much neater effect if you make the sound tell part of the story:

		Shot	*Sound*
1	*MS*	Jack scrambles in back of lorry	Door slams, engine starts.
2	*CS*	Signpost: "Leicester". Tilt to lorry as it disappears in a cloud of dust.	Lorry approaches at speed, passes and recedes.

Not only have you compressed the story into half the time, but you have kept attention on the back of the lorry, where Jack is. When recording on tape, there is the added advantage that the sound synchronisation need not be so precise. Since you do not *see* the driver slam his door, the timing need be correct only to one second instead of one-tenth of a second.

Sound can be valuable also as a continuity link. The squeal of brakes can change to the squeal of pigs at the feeding-trough. In this way you may lead from one sequence to another completely different one. Often, too, sound helps to maintain suspense. The audience are swept away from the traffic scene before they know whether the brakes were applied in time. A scream may turn into the whistle of a train—with the same tantalising abruptness. It is seldom that you can use pictures alone to change the scene at a climax in this way.

How much Sound?

To reap the greatest benefit from sound, you must plan sound and picture together. There is a temptation to use sound when it is useful and forget about it at other times. But we have seen already (p. 114) that silence in a sound film must be regarded as an effect in itself. Except for the rare occasions on which you employ the dramatic qualities of silence, you must provide sound of some sort: music, commentary or effects.

Suppose you show the postman calling at your door. It seems inevitable that you should add the sound as he knocks on the door. But if that is all you do, the rest of the shot will seem odd. Why can we not hear the slap of the letterbox, or his footsteps on the path, or the click of the gate as he leaves?

If you add one synchronised sound, therefore, you must usually provide the lot. This is by no means a simple matter,

but there are two ways out of the dilemma. Which you choose depends on how you are using sound. If you want the postman's rat-tat to have dramatic effect, you will not want to water it down with all the other sounds. So you must write your script so that there is a logical reason for hearing only the knock. And the solution here consists of putting your audience on the other side of the door. We can show perhaps the hall clock, or barometer or hat-stand. Then there is a knock and a letter falls on the mat. Somebody comes to pick it up.

Here, the sound of the knock is no longer synchronised closely to the picture. As in the lorry sequence before, we have no need of very precise timing. But more important, because we have not *seen* the knock we do not expect to hear incidental sounds from sources we can see.

The other way out involves the reservation of sound effects purely for atmosphere in cases where the lack of true synchronisation is not apparent. In this way you can introduce the appropriate effects for trains, traffic, seagulls, waves and the like. But wherever accurate timing would be essential, resort to mood music.

Occasionally you can compromise. Your postman sequence may be one of many similar shots showing him on his rounds. In this case it will be in order to superimpose each knock on suitable sprightly music. The music then appears to mask the loss of the other, quieter sounds. For this sort of sequence, the professional would undoubtedly employ a specially composed piece in which the knocks form part of the music. You can but choose a record off the shelf and try to synchronise your action in the film to the music.

Blind Shots

Magnetic tape always presents timing difficulties. It is easy enough to provide sustained effects, such as the running of a car, but problems arise when a sequence covers

the starting or stopping. To see a car move off before hearing the clutch go in is scarcely less ridiculous than hearing it accelerate while it stands still.

You can nearly always get round the difficulty by introducing a cut-away. Since it serves a special purpose in a sound film, we will give it a special name—blind shot. This is a shot which does not include the source of the sound. Temporarily it blinds the audience to the action they can hear, and it acts as a blind to cover small timing errors.

When the car is about to start, you cut away to the blind shot, a close-up of a friend waving. When you cut back, the car is already moving off. The blind shot is made sufficiently long to cover the sound of the car starting.

Dialogue

You have learnt how to use mood music and sound effects. You can readily provide your films with commentaries by an unseen speaker. Why not try to give voices to the characters on the screen?

The nearer you approach realism, the more difficult it is to achieve perfection. It is not easy to add and synchronise all the sounds associated with even a simple sequence. If you attempt to record dialogue, everything becomes more difficult still. The sound must fit the lip movements perfectly. If it is in error by only a fraction of a second, the illusion of reality is destroyed. The sound track must apparently include all the natural sounds of the sequence. Yet you must exclude many confusing noises arising from the movements of the actors. Aeroplanes and motor-cycles apparently prefer to roar past when a sound film is being made. In some cases this will involve the scrapping of expensive film stock even though the magnetic recording medium can be used again.

Problems like this are a challenge to the patience and ingenuity of the amateur. That they can be mastered is shown by the successful sound films which are produced from time to time, principally by clubs.

Lip-synchronisation

The essential of a good "talkie" is perfect lip-synchronisation. The sound must be reproduced precisely in step with the lip movements of the actors. The professional film maker achieves this by recording picture and sound on two separate perforated films which run at exactly the same speed. He can edit these separately, destroying and

restoring synchronism at will. Finally he prints sound and picture on to a single film so that their accurate timing can never be disturbed.

For the amateur, such methods are impracticable. Although a few 16-mm. sound-on-film cameras are available, their price places them in the professional class. Moreover, these cameras use a single film for recording picture and sound. The film cannot be edited, therefore, unless you make copies. Only in this way can you cut the film with the necessary 26-frame displacement of picture and sound (p. 59). If you do this, however, your film costs increase and sound quality suffers.

Which system should you use? Disc recording is scarcely suitable for use during filming because discs are difficult to edit. At the moment, cameras do not handle magnetic stripe. By elimination we are left with magnetic tape. This is easy to edit, but hard to synchronise accurately. Either you must adopt one of the professional synchronising systems or transfer the sound to film for projection.

Clapper Boards

If you attempt to record sound while you shoot the picture, you must provide some means of synchronising the two later on. The simplest way is for someone in front of the camera to clap his hands just before the action begins. The film shows his hands coming together, the sound is recorded on the tape. When the sound is transferred to film, you can see the sound of the clap quite clearly on the track. So by putting the sound and picture of the clap side by side, you can put any shot in level synchronisation (p. 60).

Instead of your bare hands, you can use a clapper board. This is a small blackboard on which exposure data and Shot and Take numbers are chalked so that you can readily identify each shot in the script. To the top of the board is hinged a strip of wood which is brought smartly against the board to provide the clap.

Provided your shots are short and the speed stability of your camera and recorder are good, you can use tape for the initial recording of lip-synchronised sound even without any synchronisation other than the clapper board.

The governor in a clockwork camera is not intended to provide the accuracy of speed control required for this purpose. You must therefore drive your camera at exactly 24 f.p.s. by a synchronous motor connected to the A.C. mains. The tape recorder must also run from the same supply and is conveniently controlled by the same switch. Before shooting begins, run through a whole reel of tape to warm up the recorder thoroughly. Record only on tape which has been re-wound several times at least a week in advance.

At each shot, adopt the following procedure:

1. Start the camera and recorder together and allow just over one second for speed stabilisation.
2. Switch to "record".
3. Use the clapper board.
4. Shoot the action.
5. Stop the camera and recorder together.
6. Switch to "playback".
7. Re-wind a length of tape equivalent to just under one second.

This last operation, together with the delayed switching to "record", removes from each recording most of the dead time allowed for speed stabilisation. It would be a needless extravagance to transfer such material to the film.

The re-recording is done in a commercial studio, but it is imperative that you use your own recorder for playback and that you again warm it up thoroughly. Re-recording *must* be done in a forward direction: running in reverse will not reproduce the original tape speed. For the same reason, it is important not to transfer the tape to another spool, to add or remove tape, or even repeatedly play back the tape before re-recording.

Provided you take these simple precautions, you will be able to produce a sound negative in which the clapper board provides perfect synchronisation at the beginning of each shot and the error at the end of a shot is less than one frame. You will then be able to edit this negative as for any negative-positive sound film. Use the clapper marks to place sound and picture in level synchronisation. Then cut both films at the same number of frames from the clap. You can thus remove the clapper marks and leave the two films cut to the same length and in synchronisation.

Working in this way eliminates the cumulative errors which are usually the bane of sound-on-tape. This is possible, however, only at the expense of transferring the sound to the negative-positive optical system. Since no method of simultaneous filming and recording is both convenient and economical, amateurs have concentrated on alternative techniques.

Pre-Recording

Even before recording equipment became generally available, amateurs were producing short "talkies" by using pre-recorded sound. Usually a commercial record was chosen as a basis for a film. The camera speed was controlled by that of the disc and the actors spoke or sang in time with the record. If you have seen similar comedy acts on television, you will have been impressed with the accuracy with which the actors mouth their parts. In professional cinema, the same technique is often employed to endow an actress with a voice better than her own.

Using this procedure, the actors will find it quite simple to act and speak in step with the sound. The difficulties are mainly mechanical. Tape presents its usual synchronisation problems. Sound on stripe must be transferred later to a stripe on the picture film. Only with sound on disc does the system work really well. Even here you are hampered by being compelled to edit the picture to suit the sound rather than the story.

Whichever sound recording system you use, you must keep the playback in step with the camera. Otherwise you will not know at what speed to project the film. Stroboscopic discs are not much use for camera speed control because you have to waste a lot of film on preliminary adjustments. The most effective compromise requires some sort of mechanical coupling to the camera. The turntable must be able to run faster than the camera, but not vice versa. Then you can play-in the episode to be filmed, starting the camera when the sound reaches the required point. The camera speed is deliberately set slightly high so that it is really the turntable governor which controls the film speed.

Apparatus for this purpose must be designed specially to suit the camera and sound equipment used. Also it is a cumbersome business setting it up for each new camera position. As a result most amateurs use a third system : post-synchronisation.

Post-Synchronisation

Instead of filming the picture to match the sound, you can record the sound to fit the final picture. This offers several advantages. The actors can concentrate on giving their best performance, unhampered by the need to keep in step with the sound. No synchronising equipment is needed for the camera. It is, therefore, fully as mobile as in a silent film.

On the other hand, it is much less easy to record sound later in accurate synchronism with the mute lip-movements of the projected film. Patience and practice work wonders, however, and the process is regularly used by professionals for the production of foreign-language versions of films.

A first essential is the knowledge of the exact lines spoken by the actors while the picture was shot. If they are working from a script, you must note every slight deviation from the written word. No matter how the sound is to be recorded ultimately, a tape recorder is invaluable for checking on the original performance. The recording need not be good as

long as you can hear clearly the words and phrasing used by the actor.

After the film is edited, provide the actors with a corrected script prepared with the aid of the tape recording. You can even edit the tape to provide a guide track with which they can rehearse their parts. Then project the film in silence and the actors try to speak their lines in step with the picture. Undoubtedly a striped film is ideal for the purpose as each attempt may be recorded until success is achieved. The knowledge that expensive film or discs are not being used at each take goes far to put the actors at ease and so contributes to a good performance.

In scripting and editing a film to which you are going to add post-synchronised sound, try to avoid extreme close-ups of characters while they are speaking. Such shots emphasise slight defects in timing which will often pass unnoticed in shots taken from farther off. An occasional close-up is permissible where the actor speaks only one word—"No!" or "Perhaps". In other cases, keep your close-ups for the characters who are listening. Begin with a medium shot of an actor as he starts speaking and then cut to the other characters as soon as reasonably possible.

Dialogue on Tape

Unless you use elaborate equipment true lip-synchronisation is not possible with tape. Even if you get good results one day, the odds are it will be unsatisfactory the next, owing to changes in capstan creep or tape dimensions. However, you can add short passages of dialogue quite effectively by a slight extension of the principles outlined.

The following short script gives an example:

	Shot	*Sound*
MS	Mother in kitchen. She opens door and looks into garden.	Music fades down. Mother calls, "Claire!—Come in dear!" Claire's voice from garden, "Coming!"

MS	Claire running across lawn towards camera. Pan to follow in *MCS* as she turns in door with Mother.	Mother asks, "Where's Tony got to?" Feet on path and steps. Claire: "He's watching trains". Music fades-up again.

These few shots enable you to combine with your ciné records, recordings of the voices of your family. Yet no great skill is required of the actors. This is important, because often you have enough difficulty getting a young child to deliver the lines you want, much less speak them in time with a picture. Using magnetic tape, you can wait half an hour, if need be, for Claire to say her few words. Then you can cut and splice the tape to put her lines in correct timing with the rest of the sound for the film.

The dialogue is here preceded and followed by music. This helps to mask the absence of natural sounds, such as the opening of the door, which demand accurate synchronisation. The music continues partway into the next sequence where Tony is seen watching the trains. Sound effects can be introduced here using the principle of blind shots (p. 127).

Do not overwork these ideas. In moderation they can be invaluable but used in excess, they are soon spotted by the audience.

Art and Realism

When you add dialogue to your films, you are taking a big step towards realism. The successful presentation of reality is, however, very much an art. Before you dismiss the rest of this chapter as long-haired nonsense, make a simple experiment. Next time you have six or seven people together in the same room, make a recording of their conversation without their knowledge.

While you are recording, you will be able to follow the conversation with perfect ease. But even if you play it back while your memory is fresh, you will find the recording confused. Everybody seems to speak at once and there are a host of thumps and bumps which you cannot identify. To

a large extent this is because the recording is reproduced by a single loudspeaker which cannot reconstruct the dispositions of the various voices. You can concentrate on a real Aunt Nellie to the exclusion of her sisters because you have only to listen to the voice by the aspidistra. Subconsciously you tell your ears to ignore all the other chatter and noise. When you listen to the loudspeaker, this is no longer possible; chatter, noise and Aunt Nellie are inextricably muddled.

This gives us food for thought. Plays, films and television all show us crowded scenes, yet we follow the conversation with perfect ease. How is it done?

On films and television, part of the success is due to clever work with the microphone. It is placed so as to pick out the voices we are meant to hear and merely suggest the less important ones.

Much more important, however, is the writing of the dialogue itself. It is made to appear natural, even to appear as though everybody is speaking at once. Yet it is not natural and no important line is ever obscured by another. The writing of good dialogue is a job you can learn only by hard work and study. When you have learnt it, you can make a living at it.

Copyright

As an individual, you would find it very convenient if you could just print all the banknotes you needed. Provided your requirements were modest, your counterfeit notes would have a negligible effect on the national economy. But if many people could do the same, our whole monetary system would soon be in chaos.

Much the same applies to music. It is an offence to perform records in public without the appropriate licences. And strictly speaking, anyone outside your family—even neighbours and friends—represent a public audience. Until the law is better defined, you must consider it a technical offence to record *anything* from the radio. There seems little harm in recording a broadcast in the morning for playback at a more convenient hour in the evening. But it is understandable that you should be discouraged from freely recording for long-term storage, least of all for public performance. If such practices became general, sales of gramophone records would slump, live performances would become uneconomical and composers' royalties would dwindle. In fact the whole economy of music would be prejudiced.

What Copyright Is

Any work of art, such as a book or piece of music, is automatically protected by copyright. This means that it cannot be printed or in any way used to earn money except with the approval of the author or composer. By the same token, it must not be used, even without earning money, in a way which will prejudice its ability to earn money. Also, since the author or composer must earn a living, he expects

to receive a small fraction of the money earned by his brain-child.

Now clearly it would be an impossible business for each composer to collect his share in respect of the earnings of each performance of each composition. So usually the composer transfers his copyright to his publishers and they in turn leave the detail work to the Performing Rights Society. Before you can perform or reproduce any copyright work in public, therefore, you must see that the performance is covered by a licence from the Society. Most public halls hold such licences already, however, so you may not need to get one specially. In any case, the licence rates are relatively low and it is no hardship to keep on the right side of the law. Remember that music remains in copyright for 50 years after the death of the composer. It may, therefore, still be protected more than a century after its composition.

With gramophone records, there is another copyright to consider. This belongs to the record manufacturers and restricts public performance of the record, or its transcription or dubbing on to disc, film, wire, or tape. You can readily obtain a licence to cover public performance, but in the normal way, permission is not given for commercial records (such as Columbia, Decca, H.M.V., etc.) to be dubbed. Several firms specialise in the manufacture of records especially for dubbing, however, and at a fixed scale of charges, readily grant the necessary permission for re-recording.

Procedure

There are four occasions on which you may have to obtain licences to meet copyright requirements:

1. If you want to perform ordinary commercial discs in public.
2. If you want to dub on to disc, film, wire or tape one of the records made specially for re-recording.

3. If you want to perform in public any such dubbed recording of copyright music.
4. If you want to play in public, and in its original state, any such record specifically intended for re-recording.

The procedure in each case is different and ranges from cheap and simple to fairly complex and costly.

To perform ordinary commercial discs in public, you must be covered by two licences. If the hall or theatre is not already suitably licenced, you must write to the

Performing Rights Society,
33 Margaret Street,
London, W.1.

Such a licence relates to the public performance of copyright music and must be obtained in advance. The fee depends on the circumstances, but for a single show by a film club it would probably be about 5s. or 7s. 6d. For an annual licence, the fee might be 9d. per show per 100 persons seating capacity of the hall.

The other licence you require covers the copyright of the gramophone company in its products. This licence must also be obtained in advance from

Phonographic Performance Limited,
144 Wigmore Street,
London, W.1.

Fees are assessed according to the type of entertainment and anticipated attendance. You must therefore apply for a licence well in advance so that the fee can be assessed and paid before the performance.

When you want to dub music from a disc on to another disc, tape or film, you need permission of the manufacturer of the original disc. Such permission is rarely given in the case of ordinary commercial discs. You must therefore select your music from those discs made expressly for re-recording purposes and normally sold only to the trade, not the public. Permission for re-recording these special

discs is readily granted on payment of the appropriate fee. This can be arranged through the

Sound Film Music Bureau Ltd.,
29 Maddox Street,
London, W.1.

Their fees depend on the film gauge (standard or sub-standard), on the type of film (commercial; advertising; or non-commercial, non-theatric), and on the countries in which it is to be shown. Most amateur films would be classed as sub-standard gauge, non-commercial, non-theatric films. For these, separate licences are not available for specific countries and you can get only a world licence. The fee for this is considerable: 30s. for each 30 seconds (or part thereof) use of each record. Fortunately, the Institute of Amateur Cinematographers has negotiated greatly reduced rates for its members

Before you reproduce in public any music dubbed as above, you must see that the performance is covered by a licence from the Performing Rights Society. The fees payable will be on the scale already outlined for the playing of "live" commercial discs, but in this instance you will not also require a licence from the Phonographic Performance Limited.

You must not reproduce in public the special discs intended for re-recording unless you have first obtained permission from the publishers. Such permission is readily granted, but you may be asked for a fee.

You must, of course, also see that the performance is covered by a licence from the Performing Rights Society.

Arrangements for Amateurs

The above formalities may appear alarmingly complex and certainly the fees for re-recording are higher than most amateurs can afford. Special arrangements made by the Institute of Amateur Cinematographers simplify procedure for members of the Institute, however, and enable them to

dub discs at much lower fees. Full details may be obtained from

The Honorary Secretary,
Institute of Amateur Cinematographers,
8 West Street,
Epsom,
Surrey.

Briefly, the advantages of the Institute's scheme are as follows:

1. By quoting I.A.C. membership, or by producing your I.A.C. Blue Book, you can purchase outright the special discs normally sold only to the cinema trade. These discs cost from 5s. to about 9s. 6d. according to running time.

2. Through the I.A.C. you can obtain permission to dub these discs at the following rates:

5s. per title per 10-inch record side.

7s. 6d. per title per 12-inch record side.

These arrangements apply only to records published by the following organisations:

E.M.I. Special Recording Dept.,
Abbey Road,
London, N.W.8.

Francis, Day and Hunter, Ltd.,
16 Soho Square,
London, W.C.2.

Bosworth and Company, Ltd.,
14–18 Heddon Street,
Regent Street,
London, W.1.

W. Paxton and Company, Ltd.,
36–38 Dean Street,
London, W.1.

Boosey and Hawkes, Ltd.,
295 Regent Street,
London, W.1.

Harmonic Music Publishing Co., Ltd.,
36 Gerrard Street,
London, W.1.

Since these firms manufacture discs expressly for use with films, their catalogues classify the records according to the mood of the music.

Presentation

When you use sound to accompany your films you must take a little extra care in your presentation. Picture and sound are complementary parts of the show. Clear sound is as important as a bright picture and extraneous noise is as irritating as stray light on the screen.

Projector Noise

Nobody likes having toffee-paper rustled in his ears when he is absorbed in the main feature. It is even more disconcerting to sit in front of a projector which makes more noise than the sound track. The ultimate discomfort, however, is that of sitting in front of a speaker heavily overloaded in an effort to drown the projector noise.

A prime essential for a good show is a minimum of projector noise. If you are using a sound-on-film projector, either optical or magnetic, this is not likely to be a great difficulty. A good sound film projector runs almost silently. On the other hand, many projectors intended only for silent films, make a good deal of noise.

The first step towards the suppression of noise is to see that it is not gratuitously increased. If you stand your projector directly on a table top, there is a probability that the table will act as a sounding-board and so amplify the sound. If you slip a sponge-rubber kneeling mat under the projector, you can usually make the machine a lot quieter. If you leave your projector mat at home, you can improvise one by using a folded blanket, rug, or even a jacket to deaden the noise. Of course, you will have to be careful to see that no hot parts of the projector scorch what goes underneath, but then this applies at all times.

Picture Steadiness

Whenever you stand the projector on a resilient surface, check that the picture steadiness is not impaired. Vibration can cause the projector beam to swing up and down rapidly, producing a fuzziness in the picture. This effect is worse with a long-focus lens and a long throw.

As a first measure, focus the gate mask on to the screen and then examine it closely with the projector running at a range of speeds. If the top and bottom edges of the mask are less sharp than the sides, the machine is vibrating appreciably. You can cure it by resorting to a firmer support, even if this increases the noise again. When the test proves satisfactory without film, do a similar test while projecting sharply focused titles.

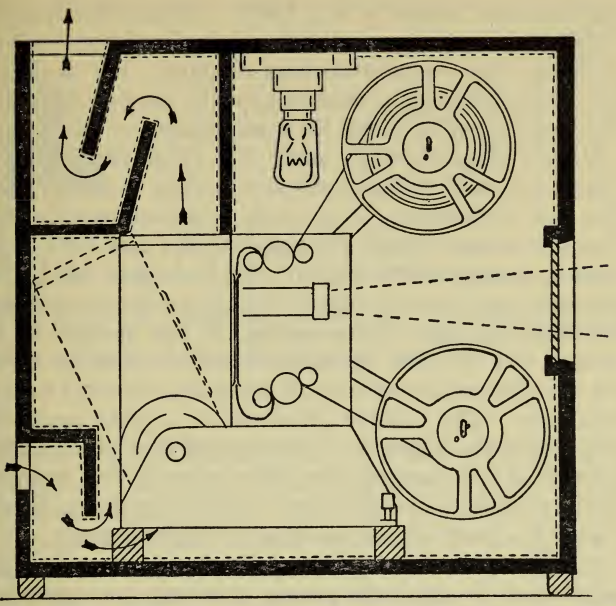
In the professional cinema these difficulties are overcome by mounting the projector on a rigid base in a separate, sound-proof room. The operator can then work in a good light without disturbing the audience.

Booths and Blimps

A few lucky amateurs have followed suit by fitting small glass or Perspex windows in a wall or door separating their audience from the projector. A window about 3×4 inches is needed for projection and a similar one for observing the screen during focusing and manipulation of the sound equipment.

Such a plan may be too ambitious for your own case, but you may do as well by projecting through an open serving hatch. To get the best isolation of the projector, you should fit two windows in a frame which pushes into the hatch opening.

When relying on twin turntables for the provision of mood music, this sort of arrangement is very convenient. It simplifies manipulation of the discs because you can operate in a good light. Also you can converse with an assistant, sharpen thorn needles and generally fuss around without disturbing the audience.



A blimp for a typical projector. The projector is lifted slightly with hard rubber feet and the large ventilation ducts are light and sound trapped. The whole case is lined with felt and the pilot light makes threading easy.

A slight drawback of the separate room is that it compels you to use a monitor speaker. This is a small loudspeaker fed from the same amplifier as the speaker by the screen. By listening to the monitor, you can tell how to adjust the volume and tone controls of your amplifier.

When you cannot place the projector in a separate room you may operate it from some sort of booth—either a specially built affair or one improvised from folding screens. Alternatively you may drape curtains over two superimposed tables. Whatever you do, remember to allow adequate ventilation since many projectors develop as much heat as an electric fire.

When space or portability is all-important, consider

running your projector in a blimp. This is merely a box with sides braced to prevent "drumming" and lined with felt or some other sound-absorbing material. The projection beam passes through a window opposite the lens and a door at the side provides access for manipulation of the controls.

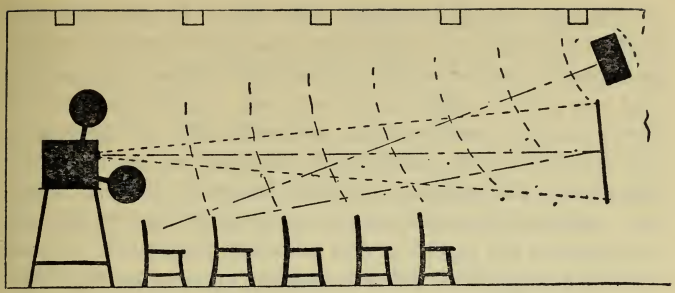
Since a blimp is usually made only a little larger than the projector, it will overheat unless you make generous provision for ventilation. You must therefore provide wide channels through which the projector fan can draw in and expel a current of cooling air. On the other hand, these channels must be so arranged that the projector noise does not escape to any serious degree. If you succeed in this respect, you will find the channels are also light-proof and you can remove the top of your lamphouse in order to assist ventilation. The relative quietness of a good sound-film projector is due largely to its being built into a blimp which serves also as a carrying case. It is instructive to study one of these machines carefully and see how ample ventilation is combined with sound-proofing and light-trapping.

When you use either a blimp or a projector booth it is usually best to stand the projector behind the audience to isolate the residual noise as far as possible.

Considerations of perspective and screen brightness limit the size of screen you should attempt to fill. So to keep the picture down to the right size in spite of a long throw, use a long-focus lens on the projector.

Speaker Position

When setting up your equipment for a show, consider carefully which is the best position for the loudspeaker. The majority of library sound-films include lip-synchronised sound (p. 129). When you are showing such a film, therefore, the sound should appear to come from the screen so that the voices seemingly come from the actors in the picture. Whatever type of film you show, you will hold the attention of the audience better if the sound seems to originate from the picture.



The best position for the speaker is usually above the screen and inclined towards the back row of the audience. A curtain hung behind the speaker will absorb the sound radiated from the back.

In the professional cinema, this effect is achieved by placing the loudspeaker behind the screen. Unfortunately this introduces difficulties. The screen has to be made from a perforated material in order to reduce the absorption of sound. Even when the perforations are so large and closely spaced as to reduce the screen reflectivity by one third, some loss of volume remains. This is most pronounced at high frequencies and consequently music may sound woolly or muffled.

Using sound-on-film, either optical or magnetically striped, the amateur cannot afford to lose the higher frequencies which contribute so greatly to clarity and realism. You must therefore compromise by placing the loudspeaker close to the screen, but not behind it. Because our ears are placed on either side of our heads, we can judge the position of a sound source quite closely in terms of bearings to right or left. On the other hand, we are readily deceived in the vertical direction. On a console television set, for example, the speaker is placed considerably below the picture. Yet we are never aware of this as we watch a programme. In fact, the enquiring child will often apply his ear to the glass before discovering the true source of the sound.

The same principles apply with films. If you place the loudspeaker above or below the screen, the sound is readily supposed to come from the picture itself. When the speaker is at one side the effect is not so good. An exception arises if you use two loudspeakers, one either side of the screen. This is an eminently satisfactory arrangement, provided you take care to phase them correctly. Incorrect phasing means that one speaker cone moves in as the other moves out. In consequence the sound is very unevenly distributed because in many parts of the room one speaker is trying to cancel the other. When this happens you can put matters right simply by reversing the leads to one speaker.

Acoustics

The acoustics of the room used determine largely whether you should place the speaker below the screen or above it. When the speaker is below the screen, people in the front row get the full output at close quarters and prevent much of the sound from reaching those at the back. Consequently people at the back may have difficulty in hearing whereas those at the front are nearly deafened.

To achieve a more uniform sound distribution, mount the speaker above the screen. The sound then passes over the front rows to reach the back of the audience. When you use this arrangement, incline the speaker very slightly. In this way you can usually get a good proportion of sound to the back without troublesome reflections off beams protruding from the ceiling.

When the ceiling is low, however, any such beams are almost certain to produce echoes which will impair the intelligibility of speech. In that case try alternative speaker positions. If these provide no cure, you may have to arrange drapes in front of, or below the beams.

Unfortunately, experiments made in an empty hall are a poor indication of the results you will obtain when the audience is seated. Not only does an audience deaden the

acoustics to some extent by absorbing sound, but it produces competitive sounds in the form of coughing, rustling and so on. In a full hall therefore you need far more volume to reach the back.

Unless you allow for this, the amplifier output may be inadequate when you have an audience, even though it was more than enough when the hall was empty. To get a rough idea of your requirements, use the following equation:

$$\text{Minimum amplifier output (watts)} = \frac{\text{Volume of room in cubic feet}}{10{,}000}$$

So for a hall measuring $100 \times 40 \times 20$ feet high, your amplifier must be rated at no less than 8 watts. This figure is conservative and may be influenced by a variety of factors such as the shape of the hall and the material used for walls and ceiling. Loudspeakers vary in efficiency also—the equation above assumes a good loudspeaker in a small box cabinet.

Back Radiation

Most loudspeakers produce sound from the back as well as the front. If this back radiation strikes a hard wall behind the screen, it will be reflected forward and confuse the sound received directly.

You can greatly reduce this trouble by hanging a curtain, or even a coat, behind the speaker to absorb the sound from the back. Do not put anything close against the back of the cabinet or you will stifle the action of the speaker and possibly increase the tendency to box resonance. One radiogram manufacturer provides an ingenious solution to this problem by closing the back of the cabinet with stacked sheets of corrugated paper. The back radiation enters the hundreds of tubes so formed without any reflection. The sound is absorbed as it passes down the tubes, so none escapes from the back.

Whenever you set up your speaker, take these simple

precautions against back radiation. It is an effect most noticeable by its absence.

Sound Apparatus

Projector well back, speaker well up. That summarises the advice so far and with a sound-on-film projector, little more need be said. But when you use tape or discs to provide the sound, you must still decide where to put the additional equipment.

Beyond doubt, the ideal is to have all your apparatus compactly arranged. If you are running the show single-handed, it is essential to have everything within arm's reach. Even when with an assistant, you cannot spread yourselves much more if you are to keep closely in touch with each other.

Occasional exceptions arise, of course. We noted some of these when we were discussing simple ways of using discs. Another example arises when you have no extension speaker for the tape recorder. In this case, you have little choice but to place the recorder close to the screen. Your tape must then begin with play-in music lasting a minute or so. This enables you to start the tape and walk back to the projector without haste. Start the projector at a selected point in the music so that the film and commentary will appear in correct synchronisation.

When space is limited, you may begrudge the space required for the twin turntables used for the provision of sound from discs. Equally the turntable operator will resent being cramped for space since he needs plenty of room to lay out his discs before and after playing them. A possible solution lies in putting the sound apparatus somewhere at the side of the screen, or even behind it. This may mean arranging a mirror so that the turntable operator can tell what is happening on the screen, but he can get along with a view much inferior to that which the audience expect.

However carefully you rehearse the show, it is helpful to have a simple system of signalling between sound operator and projectionist. You can easily contrive a suitable device

with a bell transformer, two bell-pushes and two or three flashlamps.

Try to keep the technicalities of presentation out of the public eye as far as possible. If you do place the turntables near the screen, hide them by a screen or curtain.

If things go wrong, they will be noticed less if you don't fuss. Should you get your discs muddled, go on playing any reasonably non-commital one until you sort things out. If the film breaks, let the music run on until you have got the projector going again. You can always repeat discs or hold up your tape until things are straight.

It is a great help if you can provide interval music while changing reels. Most sound-on-film projectors have provision for a gramophone input for this purpose. Of course, if you can splice all your films on a single reel you can dispense with intervals. Few projectors have the reel capacity for a really long show, however, and in any case a short break between films is often desirable.

Similar considerations apply with sound on tape. Most recorders run for only half an hour at a time. A gramophone turntable or a second tape machine is therefore useful to span the gaps.

Experiments

Amateurs have a freedom to experiment which is seldom enjoyed by the professional. It is only recently that amateurs have begun using sound to any great extent and many new fields remain to be explored. Just how much realism can you impart using sound which is not accurately synchronised? Or would you prefer to match your films to music—or poetry? Or how about trying a few stereophonic effects, some sounds coming from the screen, others from behind the audience? This is only the beginning.

INDEXED GLOSSARY

DUPE NEGATIVE. A picture negative prepared from a positive picture original and used for the production of married prints ... 61

EDGE NUMBERING. Numbers printed at every foot along the edge of negative film to facilitate cutting of the negative to match the edited work print 57

EFFECTS RECORDS. Records of sounds other than speech or music 123

ERASE HEAD. A magnet or electro-magnet used to remove the variations in magnetisation representing sound recorded on magnetic tape, wire or stripe 66

GATE MASK. The aperture in the gate channel of a projector defining the area of film projected on the screen 103

GOVERNED MOTOR. A motor which runs at a speed determined by a mechanical governor 23

HALF-TRACK. A 50-mil width of magnetic coating applied to 16-mm. sound-film to cover only half of the optical sound track. Optical and magnetic sound tracks can thus be used alternatively ... 104

HUM. An unwanted, low musical note produced when the mains supply frequency enters the amplifier used for recording or reproduction 11

INCHING. Movement of film or tape an inch or two at a time, usually by manual operation of the apparatus 78

INDUCTION MOTOR. An electric motor which runs at a speed largely but not entirely, determined by the mains supply frequency ... 23

INPUT. Electrical impulses supplied to apparatus 13

LEVEL SYNCH(RONISATION). The placing of sync. marks so that the record of a sound appears immediately opposite the corresponding picture. (As opposed to Printing Sync. q.v.) 60

LIGHT VALVE. A device for converting electrical impulses into corresponding fluctuations of a beam of light 43

LIP-SYNCHRONISATION. The synchronisation of sound within a small fraction of a second so that speech can be reproduced in synchronism with an actor's lip movements 129

MAGNETIC RECORDING. Sound recorded as variations in magnetisation of particles in a coating on film or tape or in a wire ... 40

MARRIED PRINT. Single film on to which optical sound and picture records have been combined 55

MASTER RECORDING. A complete sound record, usually made on magnetic tape, from which the final optical or disc recording is later prepared 54

MICROPHONE HOWL. The noise produced when a microphone is too near the associated loudspeaker 81

MIXING. The combination of sounds or recordings electrically so that they can be reproduced simultaneously 18

MONITOR SPEAKER. A loudspeaker indicating the volume and balance of sound being recorded or reproduced in another room ... 145

MOOD MUSIC. Music accompanying the film and enhancing the presentation 110

NOISE REDUCTION BIAS. Slow variations in the density or width of an optical sound track, introduced to minimise noise due to scratches and dust 58

NON-SYNC. Records reproduced without provision for precise synchronisation with the film 42

OPTICAL RECORDING. Sound recorded photographically along one margin of a film so that more or less light passes through the film 42

OUTPUT. Electrical impulses delivered by an apparatus 11

PADDING-OUT RESISTOR. A resistor used for preventing one part of a circuit (e.g., the volume control for a pick-up) from adversely affecting another part of the circuit (e.g., a second pick-up) ... 18

PICK-UP. A device using a needle or stylus to follow the waviness in the groove of a gramophone record and so generate corresponding electrical impulses 41

PILOT COMMENTARY. A shot-by-shot description of a film, recorded as a timing guide for subsequent recording of a commentary free from projector noise 77

PINCH ROLLER. A roller holding wire or tape in firm contact with the capstan of a magnetic recorder 69

POST-SYNCHRONISATION. The recording of synchronised effects or speech after the picture has been shot, processed and edited 60

POTENTIOMETER. Usually a circular device with a projecting spindle. Rotation of the spindle moves a contact connected to the middle one of three connections and so selects more or less of a voltage applied between the other two connections 18

PRINTING SYNCH(RONISATION). The placing of sync. marks so that the sound is 26 frames in advance of the picture, as required for printing and projection 60

RECORD/PLAYBACK HEAD (R/P HEAD). An electromagnet used to produce or detect local magnetisation of the wire, tape or stripe in a magnetic recorder 66

RECORDING LEVEL INDICATOR. A device showing when the recording impulses approach the intensity producing overloading, particularly saturation in a magnetic recorder 70

RELEASE PRINT. One of a large number of identical married prints 55

RESISTANCE. The quality which causes a material to impede the flow of a continuous electrical current. It is measured in ohms ... 13

SATURATION. A condition of a magnetic recording material in which an increase in recording impulse no longer produces a proportional increase in magnetisation 69

SCREENED LEAD. A wire covered with insulation and then with a woven braid of further fine wires 11

SEQUENCE. A series of shots depicting an episode or scene ... 116

SINGLE-SYSTEM SOUND CAMERA. A camera in which picture and sound are recorded simultaneously on to a single film 56

SPLIT-TRACK RECORDING. A method of recording several sounds side by side in the width of one normal track on magnetic tape or stripe so that the recordings are reproduced simultaneously ... 85

SPROCKET MODULATION. A throbbing of the reproduced sound due to the presence of perforations close to the sound track ... 104

START MARKS. Marks made on a film and a disc or tape so that the picture can be started in close synchronisation with the sound 74

STRIPE (Magnetic). The magnetic coating applied along one or both margins of a film and used for recording sound 97

STROBOSCOPIC DISC. A rotating arrangement of dark and light radial lines which appear stationary when illuminated by light flickering at a related frequency 21

SUPERSONIC BIAS. High-frequency impulses mixed with the impulses to be recorded and reducing the distortion of a magnetic recording system... 65

SYNCHRONISING MARK. A reference mark enabling separate picture and sound records to be brought into step 59

SYNCHRONOUS MOTOR. An electric motor which runs at a speed determined solely by the mains supply frequency 23

TAPE (Magnetic). A narrow, unperforated plastic or paper ribbon coated with magnetic oxide and used for magnetic recording... 46

THROW. The distance between projector and screen 144

TORQUE MOTOR. An electric motor designed to provide a substantially constant driving torque over a wide range of speeds ... 92

TRACKING. The movement of a pick-up from the edge of a record towards the centre so that the needle always trails substantially at a tangent to the record groove... 25

TWIN-TRACK RECORDER. A magnetic tape recorder in which less than half the width of the tape is used at once so that interchange of the spools enables a second recording to be made on the same length of tape 65

VARIABLE AREA RECORDING. Optical sound recording in which the track consists of clear and opaque areas, the complementary widths of which vary from point to point along the track 43

VARIABLE DENSITY RECORDING. Optical sound recording in which the light absorption of a constant-width track varies from point to point 43

VOLUME CONTROL. A potentiometer used to control the magnitude of electrical impulses passing in or out of an electrical device such as a pick-up, amplifier or loudspeaker 12

WORK PRINT. Another name for Cutting Copy, q.v. 55

WOW. A wailing effect produced by irregular movement of the recording medium during recording or reproduction 94

THE TECHNIQUE OF FILM EDITING *Compiled by Karel Reisz*
288 pages, 189 illustrations. **Price 30/- (Postage 9d.)**

Editing is the final and the most subtle phase of creative motion picture work; it is also the least explained or publicized. This is why the *British Film Academy* appointed a committee of ten outstanding film editors to summarize their views and experience and so present the first comprehensive guide to their craft. It is richly documented with carefully selected examples from famous films.

THE CINE ALMANAC
232 pages. **Price 15/6 (Postage 6d.)**

The first comprehensive year-book for the cine-amateur, answering his questions, and solving his problems. It tells all about technical equipment, cine clubs, the cost of cine work, how to present it, the best films of the year and outstanding personalities. Contains an up-to-date encyclopaedia of technical data and complete directories of clubs, libraries, labs., etc.

WORKING FOR THE FILMS *Edited by Oswell Blakeston*
220 pages, two-colour diagrams, tables.
Price 10/6 (Postage 6d.)

The secret about the glamour of films seems to be that not all of it is faked. After all the debunking is done, it still remains true that life around the studios can be more exhilarating, offer bigger rewards and lead to higher careers than other arts or crafts. The inspiring examples, often thrilling stories and frank advice by twenty celebrated protagonists of British films, which make up this book, prove as much and teach a lot more. They show some of the right paths to film fame.

NATURE AND MY CINE CAMERA *by Oliver G. Pike*
240 pages, 225 illustrations. **Price 15/- (Postage 6d.)**

The story of the making of nature films from the initial idea, the choice of equipment, the work in the field, to the final motion picture, complete with commentary. Photographs from films, pictorial diagrams and specimen manuscripts illustrate a warm-hearted narrative passing on decades of experience to amateur and professional, still photographer and motion-picture man alike.

FOCAL CINE CHART *by W. D. Emanuel*
2 computing discs. **Price 3/6 (Postage 3d.)**

All the technical data needed, compressed for the waistcoat pocket.

FOCAL BOOKS ON PHOTOGRAPHY

EXPOSURE
By W. F. Berg
Helps to pick the right tools and materials, to suit filters to film and subject, to determine the correct exposure.
432 pp., 140 illus. **Price 21/–**

DEVELOPING
By C. I. Jacobson, Ph.D.
Practical advice on negative technique, choosing the right chemicals and getting the right negative, passed on in straightforward language.
304 pp., 150 illus., 12th ed. **Price 15/6**

PHOTOGRAPHIC OPTICS
By Arthur Cox, B.Sc., M.A.
Every photographer should be able to discriminate between lenses just as he knows how to choose films or filters.
368 pp., 352 illus., 10th ed. **Price 17/6**

THE COMPLETE ART OF PRINTING AND ENLARGING
By O. R. Croy
How to make prints—ordinary prints, elaborately controlled or very tricky prints; a wealth of technical knowledge and personal experience.
256 pp., 200 illus., 3rd ed. **Price 19/6**

LIGHTING FOR PHOTOGRAPHY
By W. Nurnberg, F.R.P.S.
The technical roots of artificial lighting, the advantages and limitations of different light sources, the principles of their practical use.
176 pp., 297 illus., 12th ed. **Price 17/6**

PHOTO-FLASH IN PRACTICE
By Geoffrey Gilbert
Extensively revised and brought up to date. Contains blue-prints for making mains or battery electronic flash units, battery capacitor flashgun, magnetic synchronizer.
304 pp., 95 illus., 4th ed. **Price 17/6**

FOCAL FLASH DISC
By W. D. Emanuel
For use with flash bulbs or speed flash; gives correct exposure with any bulb, with any film, at any distance.
Price 5/–

STRAIGHTFORWARD DEVELOPING
By L. A. Mannheim
You need only a simple developing box and somebody to show you how. This book will do it.
96 pp., 150 illus., 2nd ed. **Price 5/–**

RETOUCHING
By O. R. Croy
This book points out the ways, picks the tools, explains the best methods, and shows correct examples.
200 pp., 304 illus. **Price 15/6**

ENLARGING
By C. I. Jacobson, Ph.D.
The photographer's ability to judge negatives, apparatus, paper and chemicals, is turned into terms of practical experience in this book.
304 pp., 136 illus., 14th ed. **Price 15/6**

PHOTOGRAPHIC ILLUMINATION
By R. Howard Cricks, F.R.P.S.
Tells all the photographer needs to know about electrical theory, the latest equipment and how to get the most out of it.
320 pp., 90 illus. **Price 17/6**

CAMERA TECHNIQUE
By H. J. Walls, B.Sc.
Surveys the theoretical principles of all aspects of photography, from light to lenses and from films to apparatus, and shows how they are applied in practical picture making.
320 pp., illus. **About 21/–**

LIGHTING FOR PORTRAITURE
By W. Nurnberg, F.R.P.S.
With extreme clarity and profuse illustrations, the author of *Lighting for Photography* here describes the manifold possibilities of lighting the human face.
192 pp., 240 illus., 2nd ed. **Price 17/6**

ALL-IN-ONE CAMERA BOOK
By W. D. Emanuel
The easy path to good photography is shown as a pleasant hobby with a technical background—the problems are simplified but not concealed.
232 pp., 80 illus., 31st ed. **Price 9/6**

FOCAL EXPOSURE DISC
By W. D. Emanuel
Presents reliable results ready for reading off at a glance just as the best types of exposure meters would do.
Price 5/–

STRAIGHTFORWARD PRINT MAKING
By L. A. Mannheim
Making your own prints is a simple job. Turn out perfect pictures every time without bother or elaborate equipment.
96 pp., 200 illus., 2nd ed. **Price 5/–**

FOCAL BOOKS ON PHOTOGRAPHY

35 mm. PHOTO TECHNIQUE
By H. S. Newcombe, F.R.P.S.
Technical factors of film exposure and development producing the perfect negative are put into the language of common sense for the practical man.
320 pp., 90 illus., 8th ed. **Price 17/6**

THE ROLLEI WAY
By L. A. Mannheim
A composite work built from the experience and advice of leading photographers, dealing with essential points of Rolleiflex or Rolleicord practice.
232 pp., 245 illus., 3rd ed. **Price 17/6**

THE CONTAX WAY
By H. Freytag
Up-to-date facts and authoritative advice on all Contax equipment applied to every conceivable Contax subject.
224 pp., 241 illus., 4th ed. **Price 17/6**

MY WAY WITH THE MINIATURE
By Lancelot Vining
Ten years more experience has gone into the thorough revision, ample additions and new illustrations of the present reissue of this work.
260 pp., 50 illus., 11th ed. **Price 15/6**

LANDSCAPE PHOTOGRAPHY
By Leonard and Marjorie Gayton
The Gaytons show how to put the landscape first and the camera second, to picture mood as much as a view.
160 pp., 44 illus. **Price 25/–**

PHOTOGRAPHY AS A CAREER
Edited by A. Kraszna-Krausz
Twenty photographers, all masters of their craft, give personal opinions and advice as to how newcomers should approach their fields of work.
208 pp., 12 diags., 3rd ed. **Price 12/6**

FOTOJOB BOOKS
Written by professionals. *Wedding Photography*, by Gordon Catling; *Group Photography*, by Gordon Catling; *Photographing Machinery*, by Bernard Alfieri.
96–112 pp., 32–34 illus. **Each 7/6**

PHOTOGRAPHS AND THE PRINTER
By Frank H. Smith
This book tells how and why and what sort of photographs will give the best results when printed by the printer.
176 pp., 62 illus. **Price 12/6**

TWIN-LENS REFLEX COMPANION
By H. S. Newcombe, F.R.P.S.
Contributions on their twin-lens technique by ten American professional photographers of world-wide fame complement advice to beginner and advanced worker.
320 pp., 90 illus., 3rd. ed. **Price 17/6**

THE RETINA WAY
By O. R. Croy
Will put the whole Retina technique safely in your hands and bring all the subjects of Retina photography within your easy reach.
240 pp., 214 illus., 3rd ed. **Price 17/6**

THE LEICA WAY
By Andrew Matheson
Covers the whole technique and art of Leica photography both with the latest equipment and older models and accessories.
402 pp., 307 illus., 2nd ed. **Price 21/–**

WITHOUT ASSIGNMENT
By Howard Byrne
The author's camera adventures in Europe and the United States reveal a vast amount of "know-how" about freelance photo-journalism.
200 pp., 70 illus. **Price 17/6**

MARKET FOR PHOTOGRAPHS
How to get your pictures published. A comprehensive directory setting out the types of pictures editors want, their terms of payment, etc.
224 pp. **Price 10/6**

BUSINESS OF PHOTOGRAPHY
By Charles Abel
The author is the Executive Manager of the Photographers' Association of America. A British running commentary adds world-wide usefulness to the book.
416 pp. **Price 16/6**

MEDICAL PHOTOGRAPHY
By T. A. Longmore, A.R.P.S., M.S.R.
The photographic background on which the radiographic and the clinic camera-worker rely. Strictly factual and exhaustive.
1012 pp., 440 illus., 4th ed. **Price 50/–**

PHOTOGRAPHY AT SCHOOL AND COLLEGE
By M. K. Kidd
For active but impecunious young people, showing short cuts to successful photography in general and dealing especially with the subjects that interest them.
200 pp., 211 illus. **Price 7/6**

FOCAL CHARTS

FOCAL DEVELOPING CHART
By W. D. Emanuel

The right developing time at any temperature for your film and developer, fresh or used.

FOCAL EXPOSURE CHART
By W. D. Emanuel

Anywhere, any time, any subjects, any light, any camera, any film.

FOCAL FILTER CHART
By W. D. Emanuel

The right filter, the right film, the right light, the right stop, the right speed for the right subject.

FOCAL FOCUSING CHART
By Arthur Cox

Sharp focus, safe depth, with any lens or attachment.

FOCAL LIGHTING CHART
By W. D. Emanuel

Simple lighting schemes, tested lamp positions, exact exposure values.

FOCAL STOP AND SPEED CHART
By E. Steffens

A whole library of facts on exposure, depth and action.

FOCAL FLASH CHART
By W. D. Emanuel

Flash exposure disc, sun-flash exposure disc, ten typical set-ups.

FOCAL CINE CHART
By W. D. Emanuel

All the technical data needed.
Price 3/6 each (Postage 3d.)

FOCAL ENLARGING CHART
By W. D. Emanuel

Measures exposure, ensures sharpness, defines magnification.
Price 7/6 (Postage 6d.)

CAMERA GUIDES

SPORTSTER GUIDE
By A. J. Surgenor

BOLEX GUIDE
By A. J. Surgenor
Price 7/6 each (Postage 6d.)

LEICA GUIDE
By W. D. Emanuel

ROLLEIFLEX GUIDE
By W. D. Emanuel

EXAKTA GUIDE
By W. D. Emanuel

CONTAX GUIDE
By W. D. Emanuel
Price 6/6 each (Postage 3d.)

ROBOT GUIDE
By W. D. Emanuel
Price 5/6 (Postage 3d.)

KORELLE GUIDE
By W. D. Emanuel

R.F. IKONTA GUIDE
By W. D. Emanuel

RETINA GUIDE
By W. D. Emanuel

SELFIX GUIDE
By W. D. Emanuel

VITO GUIDE
By W. D. Emanuel

PURMA GUIDE
By Frederick Purves

VITESSA GUIDE
By W. D. Emanuel

ISOLETTE GUIDE
By W. D. Emanuel

KARAT GUIDE
By W. D. Emanuel

NETTAR GUIDE
By W. D. Emanuel

CONTESSA GUIDE
By W. D. Emanuel

SILETTE GUIDE
By W. D. Emanuel

BESSA-PERKEO GUIDE
By W. D. Emanuel
Price 4/6 each (Postage 3d.)

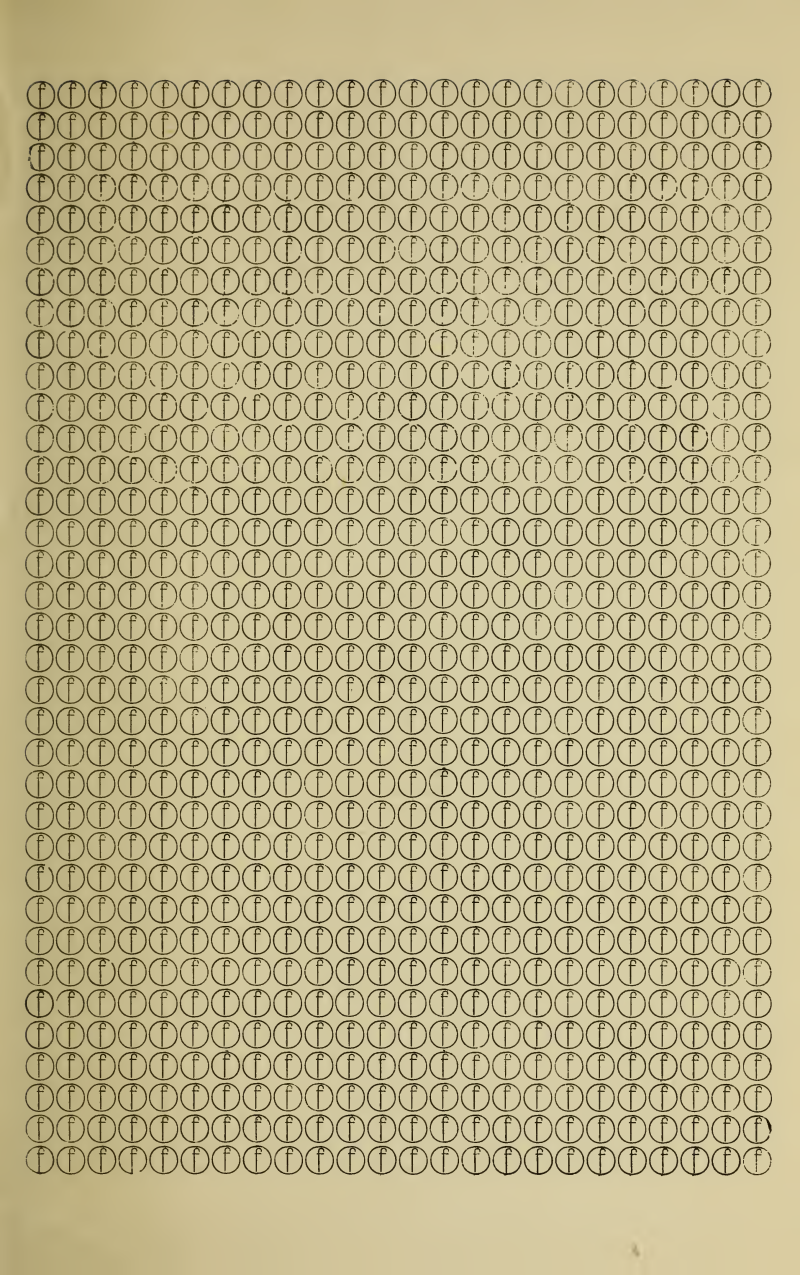
FUL-VUE GUIDE
By Marcel Natkin
Price 2/6 (Postage 3d.)

The Most Popular Photographic Library in the World; 2/– each

1. All About FOCUSING and Your Camera, by *F. W. Frerk*
2. All About SUNSHINE and Your Camera, by *Edwin Smith*
3. All About FILTERS and Your Camera, by *C. I. Jacobson*
4. All About PORTRAITS and Your Camera, by *Hugo van Wadenoyen*
5. All About EXPOSURE and Your Camera, by *C. I. Jacobson*
6. All About TAKING ACTION with Your Camera, by *Alex Strasser.*
7. All About LANDSCAPES and Your Camera, by *Hugo van Wadenoyen*
8. All About FORMULAE in Your Darkroom, by *C. I. Jacobson*
9. All About DAYLIGHT INDOORS and Your Camera, by *Hugo van Wadenoyen*
10. All About IMPROVING NEGATIVES in Your Darkroom, by *F. W. Frerk*
11. All About WINTER PHOTOGRAPHY and Your Camera, by *Edwin Smith*
12. All About TRACING TROUBLES in Your Photographs, by *A. Merryweather*
13. All About LIGHTING WITH ONE LAMP and Your Camera, by *H. van Wadenoyen*
14. All About LIGHTING WITH TWO LAMPS, by *Hugo van Wadenoyen*
15. All About COMPOSITION and Your Camera, by *A. Kraszna-Krausz*
16. All About IMPROVING PRINTS in Your Darkroom, by *F. W. Frerk*
17. All About AGAINST THE SUN EFFECTS and Your Camera, by *H. van Wadenoyen*
18. All About PHOTOS IN YOUR GARDEN and Your Camera, by *R. M. Fanstone*
19. All About COPYING and Your Camera, by *H. W. Greenwood*
20. All About MAKING ENLARGEMENTS in Your Darkroom, by *C. I. Jacobson*
21. All About PROCESSING in Your Darkroom, by *C. I. Jacobson*
22. All About ARCHITECTURE and Your Camera, by *R. M. Fanstone*
23. All About SELLING PHOTOGRAPHS, by *Bernard Alfieri*
24. All About SPORTS AND GAMES and Your Camera, by *Lancelot Vining*
25. All About PICTURES IN TOWN and Your Camera, by *Hugo van Wadenoyen*
26. All About CHILDREN OUTDOORS and Your Camera, by *Hugo van Wadenoyen*
27. All About CAMERAS and How to Choose Yours, by *Bernard Alfieri*
28. All About CATS AND KITTENS and Your Camera, by *Philip Johnson*
29. All About DOGS AND PUPPIES and Your Camera, by *Philip Johnson*
30. All About CHILDREN INDOORS and Your Camera, by *Hugo van Wadenoyen*
31. All About MOTHER AND CHILD PICTURES and Your Camera, by *T. P. H. Miller*
32. All About LIGHTING FOR GLAMOUR and Your Camera, by *W. Nurnberg*
33. All About FLASH PHOTOGRAPHY and Your Camera, by *F. W. Frerk*
34. All About NIGHT PHOTOGRAPHY and Your Camera, by *F. Purves*
35. All About MAKING CONTACT PRINTS from Your Negatives, by *Betti Mautner*
36. All About USING A MINIATURE CAMERA, by *Percy W. Harris*
37. All About TAKING WEDDINGS with Your Camera, by *Gordon Catling*
38. All About TAKING BABY and Your Camera, by *W. Suschitzky*
39. All About PRINT FINISHING, by *R. M. Fanstone*
40. All About TAKING COLOUR, by *C. L. Thomson*
41. All About COLOUR OUTDOORS, by *George Wells*
42. All About COLOUR INDOORS, by *George Wells*
43. All About PORTRAITS IN COLOUR, by *George Wells*
44. All About BUILDING YOUR OWN ENLARGER, by *Gordon Catling*
45. All About MAKING CAMERA GADGETS, by *L. C. Mason*
46. All About PROCESSING 35 mm. FILM, by *Percy W. Harris*
47. All About TAKING PARTIES AND GROUPS, by *Gordon Catling*
48. All About TAKING PICTURES IN THE HILLS, by *C. Douglas Milner*
49. All About MAKING LIGHTING GADGETS, by *L. C. Mason*
50. All About TRAVELLING with Your Camera, by *Edward Richardson*
51. All About PHOTOGRAPHING SHOWS, by *Angus Wilson*
52. All About TAKING GREAT OCCASIONS with Your Camera, by *Gordon Catling*
53. All About GLAMOUR IN COLOUR, by *George Wells*
54. All About CHILDREN IN COLOUR, by *George Wells*
55. All About FLASH AND COLOUR, by *George Wells*
56. All About YOUR HOLIDAYS IN COLOUR, by *George Wells*
57. All About MAKING DARKROOM GADGETS, by *L. C. Mason*
58. All About MAKING A FLASHGUN, by *M. M. Warner*
59. All About NEGATIVE RETOUCHING, by *J. E. Redon*
60. All About COLOURING Your Photographs, by *R. M. Fanstone*

ALL POSTAL ENQUIRIES

relating to this book
or to any other photographic
or cine problem are answered
by the Focal Press
without charge
if a stamped addressed
envelope is enclosed
for reply



Focal MovieBooks tell the secrets of making good movies. Focal MovieBooks show you the best methods of successful technique. Focal MovieBooks map out commonsense ways to the art of the amateur. Focal MovieBooks are written by practical men who know the tricks of the great professionals and also know how to make them easy, even for beginners. Focal MovieBooks are in plain English that does not hide "hot air" behind complicated words. They fully explain all technical terms and make a point of illustrating everything worth illustrating. Focal MovieBooks give chapter and verse for home movie making.

SOUND may be said to add an extra dimension to the moving picture. It brings the image on the movie screen one step nearer to reality, for most of us take in life with our ears as well as our eyes. At one time sound used to be a highly specialized business. But as **D. M. Neale** *shows in this book, there are now many ways in which the amateur movie enthusiast—whether he works with 8 mm., 9.5 mm. or 16 mm. material—can turn his silent movies into talkies. Some of the methods call for little more than playing suitable phonograph records at the right time. On the other hand the more advanced optical, and especially magnetic, procedures described here make the home movie worker almost as versatile as a professional motion picture studio.*